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U.S. Department of Transportation

Federal Aviation Administration

SEMI-FLUSH FLASHER LIGHT UNIT AND INTERFACE AND CONTROL UNIT FOR APPROACH LIGHTING SYSTEMS

PERFORMANCE SPECIFICATION

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1 SCOPE

This specification sets forth the requirements for a semi-flush mounted flashing light fixture along with an interface and control unit to allow use with two FAA standard Approach Lighting Systems (ALSs) systems: the Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) and High Intensity Approach Lighting System with Sequenced Flashing Lights (ALSF-2). In this document, the flashing light fixture will be referred to as the "Light Fixture" and the interface and control unit will be referred to as the Individual Control Cabinet, abbreviated as "ICC". The combination of the light fixture and ICC will be referred to as the "Flasher Unit" or as "the equipment".

This specification also covers the use of snow plow rings that are used with these fixtures to prevent damage from snow removal equipment.

2 APPLICABLE DOCUMENTS

2.1 General

The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they shall meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government Documents

2.2.1 FAA specifications, Standards, Handbooks, and Advisory Circulars

The following specifications, standards, handbooks, and Advisory Circulars form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FAA-D-2494	Technical Instruction Book Manuscripts: Electronic, Electrical and Mechanical Equipment, Requirement for Preparation of Manuscript and Production of Books
FAA-E-1100	Photometric Test Procedures for Condenser Discharge Lamp
FAA-E-2980	Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR)
FAA-E-2952	Approach Light, Chemical Resistant, High Intensity, Semi-Flush, Steady Burning
FAA-G-2100	Electronic Equipment, General Requirements
FAA-E-2689	Dual Mode High Intensity Approach Lighting System (ALSF-2/SSALR)
AC 150/5345-26	Specification for L-823 Plug & Receptacle, Cable Connectors
AC 150/5345-42	Specification for Airport Light Base, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-53	Airport Lighting Equipment Certification
ANSI/ASME B46.1	Surface Texture, Surface Roughness, Waviness and Lay
NAS-SR-1000A	National Airspace System System Requirements Specification

2.2.2 Military and Federal Publications

The following military and federal publications form a part of this specification and are applicable to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

2.2.2.1 Military Specifications

MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-DTL-13924	Coating, Oxide, Black, for Ferrous Metals
MIL-DTL-7989	General Specification for Covers, Light Transmitting for Aeronautical Lights

2.2.2.2 Military Standards

MIL-STD-276	Implementation of Porous Nonferrous Metal Casting and Powdered Metal Components
MIL-HDBK-454	Guidelines for Electronic Equipment
MIL-STD-461	Requirements for the Control Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-810	Environmental Test Methods
MIL-STD-889	Dissimilar Metals
MIL-HDBK 472	Maintainability Predictions
MIL-STD-202	Test Method Standard Electronic and Electrical Component Parts
MIL-HDBK-338B	Electronic Reliability Design Handbook

2.2.2.3 Federal Specifications

ZZ-R-765	Rubber, Silicone; Low and High Temperature and Tear Resistant
QQ-Z-325	Zinc Coating, Electrodeposited, Requirements for
QQ-P-416	Plating, Cadmium (Electrodeposited)

2.2.2.4 Federal Standards

FED-STD-123	Marking for Shipment (Civil Agencies)

2.3 Non-Government Documents

The following industry publications form a part of this specification and are applicable to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

2.3.1 Institute of Electrical and Electronic Engineers

IEEE C62.41.2-2002	Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits

2.3.2 American Society for Testing and Materials (ASTM) Standard

ASTM A890/A890M	Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex Austenitic/Ferritic) for General Application

2.3.3 American National Standards Institute (ANSI) Standard

IPC-CC-830	Insulating Compounds, Electrical (for Coating Printed Circuit Assemblies)

(Copies of applicable FAA specifications, standards, and drawings may be obtained from the Contracting Officer in the Federal Aviation Administration office issuing the Screening Information Request (SIR), Invitation For Bid (IFB), or contract involved, or other use to be made of the requested material.)

(Military specifications and standards may be obtained from the Department of Defense Single Stock Point for military specifications, standards and related publications at http://dodssp.daps.dla.mil.)

(Information on obtaining Federal specifications and standards may be obtained from General Services Administration offices in Washington, D.C.; Atlanta; Boston; Chicago; Denver; Kansas City, Missouri; New York; San Francisco; and Seattle.)

(ASTM documents may be obtained from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428, or from: http://www.astm.org/.)

2.4 Order of Precedence

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3 REQUIREMENTS

3.1 Equipment to be Furnished

Each flasher unit is to be designed in accordance with all specification requirements and shall include the items below:

a. ICC
b. Light Fixture
c. L-823 Receptacle Plug Kits
d. Snowplow Rings

Light bases are not to be furnished with the equipment.

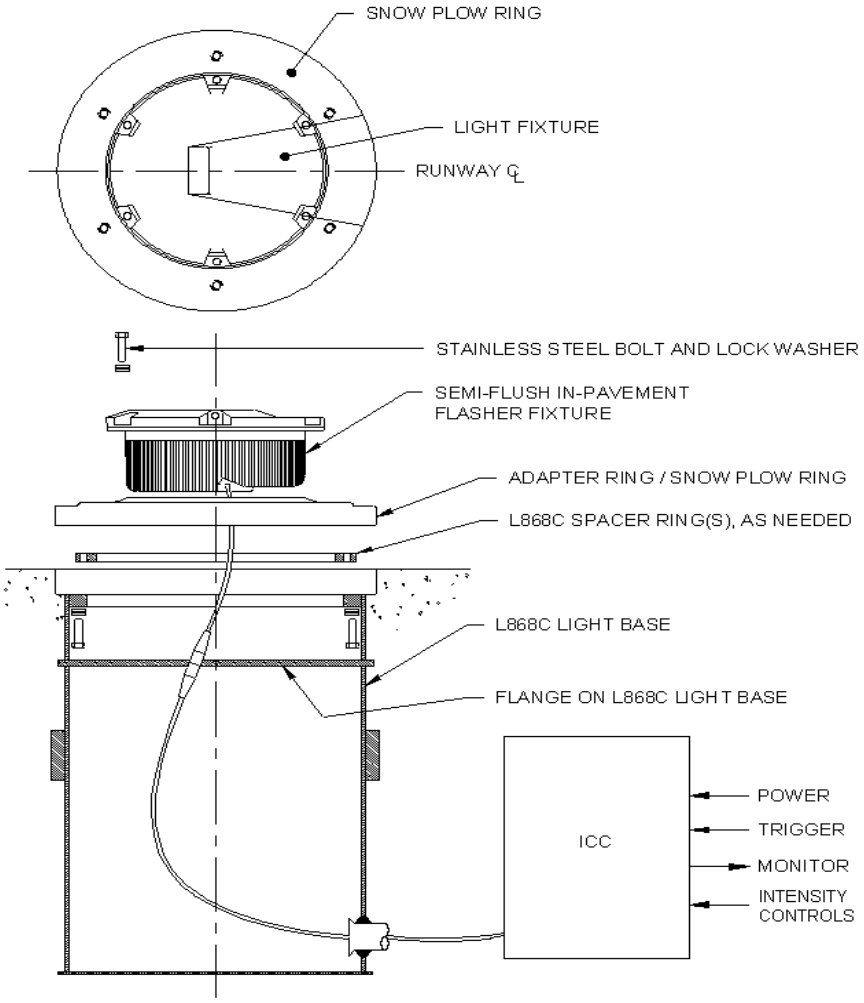

FIGURE 1. Light Fixture, Flasher Unit, Snow Plow Ring and Interface Control Unit/Individual Control Cabinet

3.2 General Requirements

3.2.1 Functional Requirements

The flasher units specified herein shall be designed for use in airport runways as a unidirectional light (see Figure 1). During operations, the flasher units will be subjected to the forces of aircraft operations as well as airport service vehicles. The light fixtures shall be designed for mounting in a Type L-868 C light base, C (15- inch) as described in FAA Advisory Circular 150/5345-42 [Specification for Airport Light Base, Transformer Housings, Junction Boxes, and Accessories]. The light base is to be embedded in a concrete or asphalt runway. The light fixture shall be designed so that it can be mounted in a light base along with a snowplow ring or adapter ring to resist damage to the top of the light fixture caused by snowplow blades. The light fixture shall be designed and tested such that it does not negatively impact aircraft operations. The light fixture shall be controlled by the ICC.

The light fixture shall consist of a top cover assembly, an optical assembly, and a bottom cover assembly. The ICC enclosure shall consist of a rain-tight enclosure and shall provide interfaces to the existing MALSR or ALSF-2 units. All parts shall be mounted in such a manner as to ensure the flasher unit will withstand shocks and vibrations caused by aircraft or service vehicle. Adjustment and repairs shall be accomplished with commercially available tools. Means shall be provided on the light fixture to permit its removal for maintenance purposes; by one maintenance technician working alone, e.g., pry bar slots, indentations, extraction devices, or other suitable provisions.

3.2.2 Photometric Requirements

The flasher units shall be designed to operate at three intensities as identified in Table I. These intensities shall be controlled by the ICC according to control signals received from the MALSR or ALSF-2 controllers.

TABLE I. Light Intensities

Intensity Setting	Maximum Allowable Effective Intensity (Candelas)	Minimum Effective Intensity (Candelas)
High	20,000	5,000
Medium	2,000	500
Low	600	150

Effective intensity measurements are to be made per FAA-E-1100. The effective intensity after a minimum of 250 hours of continuous operation (approximately 1.8 million flashes) shall be at least 70 percent of the initial value. The flash rate shall be 120 +/- 2 per minute for all three intensities. Two or more consecutive lamp misfires shall not be allowed. The design of the units shall prohibit random flashing. The flasher units shall produce flashes only when triggered by the MALSR or ALSF-2 controller. The flash duration between the beginning and end of that part of the flash when the instantaneous intensity exceeds the effective intensity shall be in the range of 250 to 15,000 milliseconds.

The minimum illumination value shall be required to enclose an area of at least 10° vertically by 30° horizontally as follows: Within 2° to 12° above horizontal and within 15° left to 15° right of

the vertical centerline of the light fixture as shown in Figure 2. The intersection of the major and semi major axes of the ellipse shall be at 7°±½° above the horizontal.

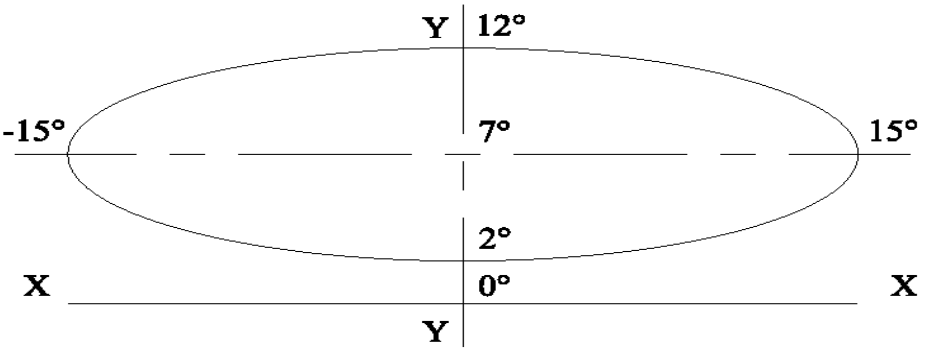

FIGURE 2. Diagram of the Minimum Illumination Area

A one-degree shift in the light pattern is permitted upward, left, or right. A downward shift shall be not greater than one-half degree. A slight infringement of lesser candela values is permissible if not more than 28 square degrees of the specified light pattern is affected with light intensity not less than 85 percent of the specified value. The light pattern shall not cut off abruptly at the outer edges of the specified light pattern, but shall decrease gradually in intensity beyond the specified areas. The corners may be rounded on a 5° radius to enable compliance with photometric values.

If the light fixture has a downward sloping light channel toward the light windows such that part of the window area could be obstructed by water, the resulting light intensity with the obstructed portion of the windows blanked out shall be at least 50 percent of the minimum value specified.

3.2.3 Physical Requirements

3.2.3.1 Light Fixture

3.2.3.1.1 Dimensions

The light fixture shall be mounted on an L-868 C light base, using a snow plow ring or adapter ring, with six 0.375 inch high-strength stainless steel bolts, flat washers and lock washers, as specified in paragraph 3.3.11, using a silicone or neoprene O-ring, as specified in 3.3.12. Interface details and dimensions of L-868 C light bases are shown in AC 150/5345-42. Critical interface areas of the light fixture are the outer diameter, top flange, bolt holes, and throat projection. The light fixture shall have a projection that extends at least 0.25 inch down through the top flange of the L-868 C light base. The diameter of this projection shall be 0.06 in +0.00/-0.01 inch less than the nominal diameter of the top flange cutout of the L-868 C light base. The light fixture shall be designed to mount on an L-868 C base, whose top surface is 0.375 inch below grade or may be designed to fit atop a base placed up to 1.25 inches below grade. The

light fixture bolt hole configuration shall match the top flange of the light base. In addition, the axis between one pair of bolt holes on opposite sides of the light fixture shall be perpendicular to the direction of the runway centerline.

The top outer edge of the light fixture shall be at pavement elevation from: +0.00 to - 0.0625 inch when installed in the light base. No part of the light fixture shall exceed 0.75 inch height above the pavement. All edges above the pavement shall be rounded to no less than 0.0625 inch radius.

3.2.3.1.2 Configuration

The light fixture shall have 30 inches of electrical conductor to connect the light fixture to the plug receptacle. The cables shall be clamped to the base of the light fixture to provide strain relief for cables. The light fixture shall operate when the physical separation, as determined by the length of the interconnecting cable(s) between the light fixture, and the ICC is up to 450 ft of cable distance. All conductor wires are to be insulated copper, size #16 AWG or larger, as required (this information provided for reference and is not part of this specification). The light fixture shall have an internal interlock switch. The function of the interlock is to disconnect and discharge any unsafe voltages when the fixture is opened.

3.2.3.2 Top Cover Assembly

The top cover assembly shall withstand pressure from tires, mechanical impact, thermal shock, and vibration without damage or loss of the watertight seal. The top surface of the light fixture shall be stainless steel or anodized aluminum and shall be smooth and free of sharp projections, which could damage tires and engage with snowplow blades. Any O-ring grooves shall have a surface finish of 64 micro-inches root mean square (RMS) maximum as defined in ANSI B46.1. The surface on the light fixture that mates with the light base flange shall have a smooth finish to provide good load transfer and sealing. The seating surfaces of the mating parts shall be flat to ensure seating without rocking before being secured. No part of the top surface that protrudes above finished grade, excluding recesses, light windows and light channels, shall have a slope greater than 16 degrees.

3.2.3.3 Bottom Covers Assembly

The bottom cover shall be airtight and watertight. Seals used shall prevent breathing with internal pressure changes due to varying lamp heat. Pressure within the light fixture shall not exceed 20 psi under any operating condition. A fitting shall be supplied to allow pressurization of the sealed optical assembly. The fitting may be permanent, or a plug may replace it for installation. The purpose of this fitting is to test the seals after field maintenance.

An external ground lug of an appropriate type, based on the manufacturer's design, shall be included as part of the light fixture's external bottom cover assembly and no holes in the bottom cover assembly will be used in conjunction with this ground lug. The external ground lug shall accommodate at least a 6 gage wire. The external ground lug shall be located so as not to interfere with light base insertion/extraction.

A nameplate designed in accordance to FAA-G-2100H for outdoor use only shall be attached to the bottom cover directing the installer to:

a. Apply anti seize compound to each of the bolts when attaching the light fixture to the light base

b. Torque the bolts between ___ to ___ inch-lb. (Contractors shall fill in values)
c. Avoid the use of an impact wrench to tighten the bolts

3.2.3.4 Optical Assembly

The optical assembly shall produce aviation white light output as required by section 3.2.2. The optical assembly shall contain the lamp(s), lamp holder(s), lamp retaining hardware, interior lens(es), and reflector(s). Reflector(s) shall be provided with a finish of high specular reflectivity and shall be protected from dirt, tarnishing, and corrosion. The design of the optical assembly shall require no optics adjustment in the field.

The optical assembly shall have one flash tube if that is the technology used. The light window of the light fixture shall have an internal flange that will prevent the lens from being pushed back into the interior of the light fixture. The clearances between the lens and the metal surfaces of the light shall prevent cracking of the lens when the light fixture is subjected to the conditions specified herein. The clearance shall be chosen such that the possibility is minimized for shards of the Teflon\rubber snowplow blade edges to penetrate the area between the lens and the adjacent metal surfaces and cause leakage.

The optical components shall be keyed so that they may not be reassembled incorrectly. Every time the lamp is replaced it shall be accurately and firmly positioned at the proper focal point. Any interior lenses shall be positioned in a secure manner. When the light fixture has been reassembled after maintenance, all components shall be properly aligned, water resistance shall be restored, and the required photometric characteristics maintained.

3.2.3.5 Individual Control Cabinet (ICC)

Each flasher fixture is controlled by an individual control cabinet, which houses triggering circuits, terminal blocks, and lightning arrestors. A safety interlock switch is incorporated into the enclosure to discharge the flash lamp power circuitry when the cabinet door is opened. The ICC can connect to one flasher or optionally. The ICC includes an anti-condensation heater. As soon as power is applied the anti-condensation heater(s) can activate, even if the flasher light system is switched off.

3.2.3.5.1 Dimensions

The cabinet shall be of sufficient size to accommodate all necessary components and wiring. Unsoldering of wires, wire harnesses, parts or assemblies shall not be required in order to gain access to terminals, soldered connections, mounting screws and the like during routine servicing and maintenance. When it is necessary to displace a part in order to check or remove another part, the former part shall be wired and mounted so that it can be moved without being disconnected and without causing circuit detuning or instability. Removal of the front panel or any sub-chassis for maintenance purposes shall be accomplished without unsoldering or soldering of connections. The equipment shall automatically return to normal operation when input power is restored after a power interruption. All test points and controls for adjustments shall be located to preclude accidental shock to personnel engaged in normal operating or maintenance activities. Maintainability requirements for the cabinet shall be in accordance with FAA-E-2100H, section 3.2.4, Maintainability. The ICC shall have a maximum weight of 50 lbs (22.72 kg).

3.2.3.5.2 Configuration

The individual control cabinet components shall be packaged in an outdoor, water proof, dust tight, non-ventilated enclosure as specified herein (see Figure 3). The cabinet shall be constructed of anodized aluminum or stainless steel and shall not bend or distort under normal methods of shipping, handling, and installation. Cabinet installation provisions shall include two 2-inch (5.08 cm) threaded fittings on the bottom surface of the cabinet along with mounting lugs located on the rear surface of the cabinet. A third fitting shall be furnished on the bottom of the cabinet surface to accommodate a 0.75 inch (1.9 cm) flexible conduit. Warning signs shall be installed inside and outside the cabinet to warn of the presence of high voltages. Maintenance light shall be provided for servicing the interior of the cabinet.

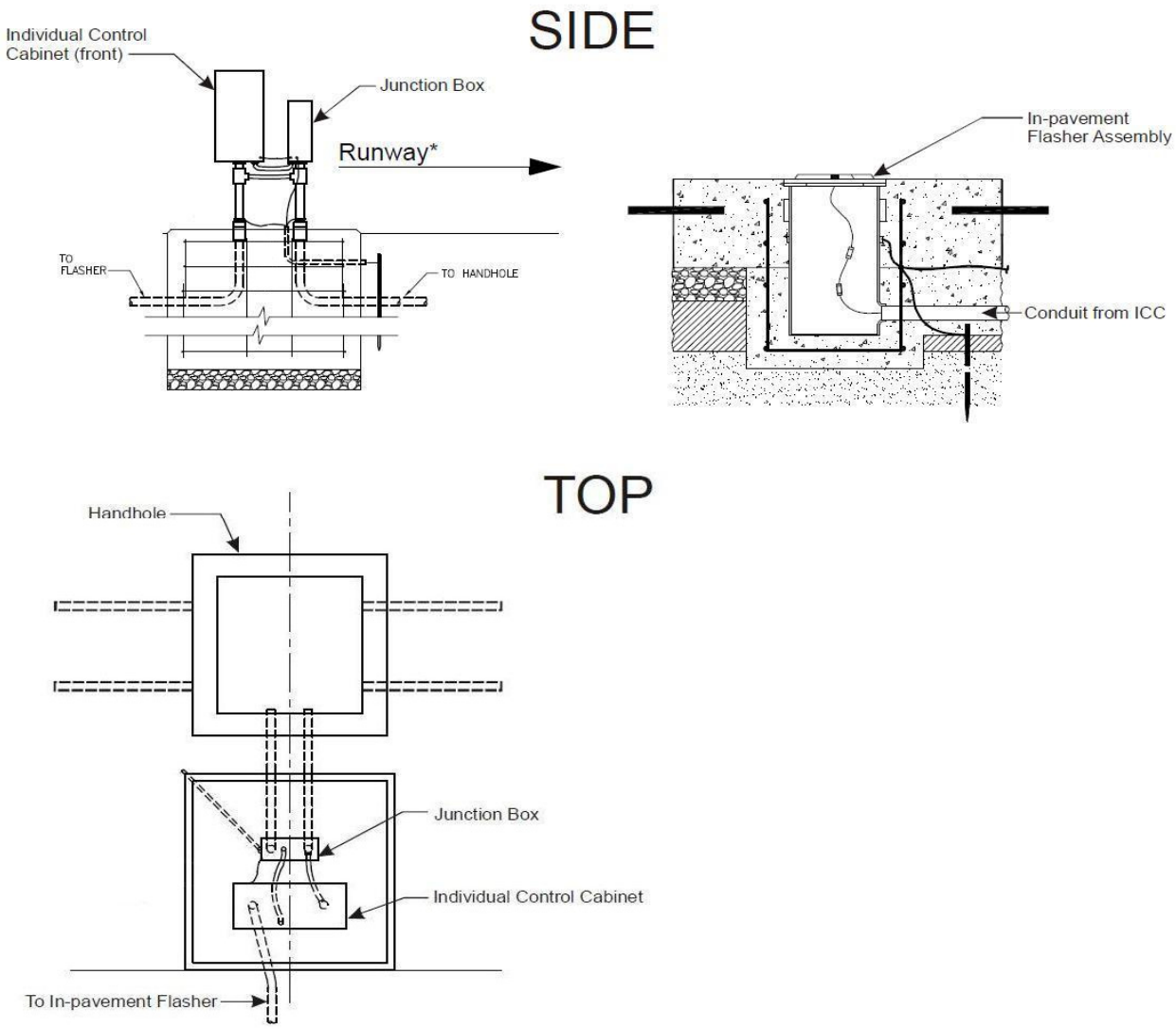

FIGURE 3. ICC Mounting Side and Top View

3.2.3.5.3 Interfaces

The ICC shall meet the interface requirements of a MALSR or an ALSF-2 (see Figure 5) as contained in the references of Table II.

3.2.3.6 Snow Plow Ring

The snow plow ring, if used, shall not interfere with installation of the light fixture in the light base or degrade the photometric performance of the light fixture below minimum requirements (see Figure 4). The snow plow ring shall not block the light. This is an adapter ring that is used to provide additional protection to the light fixture from the direct impact of snowplows. Snowplow rings have to met all environmental and load torque requirements. The light fixture can be used with or without the snow plow ring.

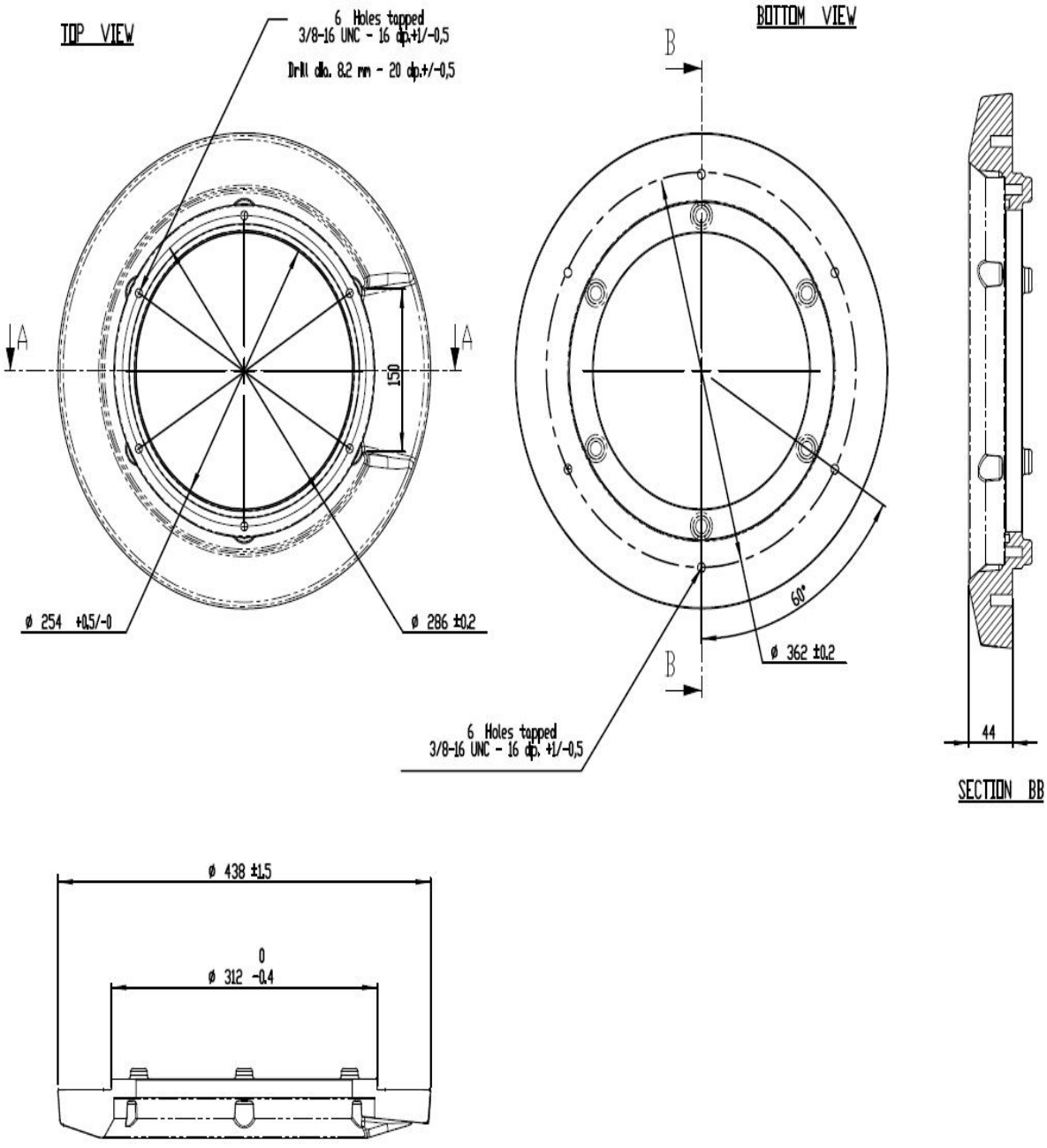

FIGURE 4. Snow Plow Ring

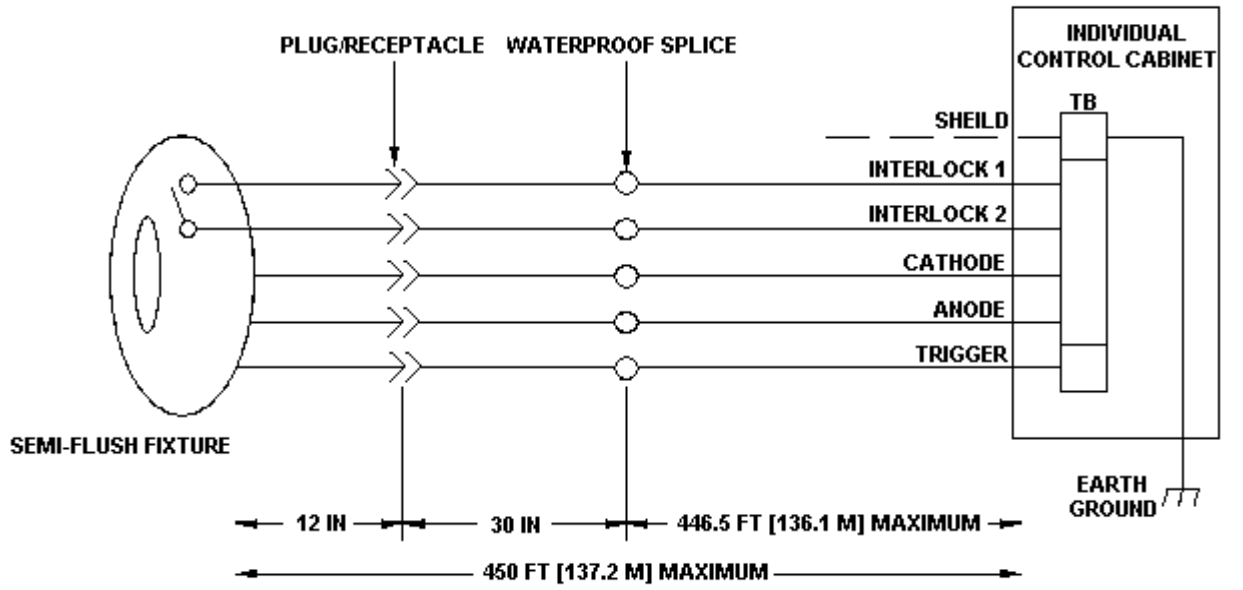

FIGURE 5. In-pavement Flashing Fixture Interconnecting Wiring

TABLE II. ICC Interface with MALSR and ALSF-2

Equipment	Reference
MALSR	FAA-E-2325
ALSF-2	FAA-E-2689

3.2.4 Environmental Requirements

The equipment shall be designed for outdoor installation and operation and is to be capable of performing satisfactorily within the environmental conditions listed below. Procedures for environmental testing shall be in accordance with the applicable sections of Section 4, Verification.

3.2.4.1 Temperature

The equipment shall withstand ambient temperatures that range from -67°F (-55°C) to +158°F (+70°C). Temperature inside and outside of the light fixture shall be held to the minimum by utilizing efficient heat dissipation techniques and materials with high coefficients of heat transfer. The maximum allowable external top surface temperature in still air shall be 302°F (150°C). The maximum allowable external top surface temperature with a tire of a heavy vehicle resting on the light fixture shall be 320°F (160°C).

3.2.4.2 Temperature Shock (Thermal Shock)

The external surfaces (including lenses) shall withstand exposure to a sudden application of cold water at a temperature of +32°F to +41°F (0° to +5°C) when the flasher unit has reached a stable operating temperature.

3.2.4.3 Altitude

The pressure altitude shall range from -300 feet (-91.44 meters) to 10,000 feet (3,048 meters).

3.2.4.4 Humidity
The equipment shall withstand relative humidity up to 100 percent, including conditions where condensation takes place in the form of both water and frost.

3.2.4.5 Sand and Dust
The equipment shall tolerate windblown dust particles of 20±5µm mean diameter blowing at 1750 ft/min (8.9m/s) and sand particles of 150 to 850 µm blowing at 3540 ft/min (18 m/s).

3.2.4.6 Rain
The equipment shall be capable of withstanding windblown rain at a rate of 6 in/hr (1.6 mm/min) at wind speeds of 40 mph (18 m/sec).

3.2.4.7 Salt Fog
The equipment shall be capable of withstanding salt and potassium-laden atmospheres with relative humidity as stated in 4.5.8.1 and 4.5.8.2.

3.2.4.8 Immersion:
The light fixture shall be capable of withstanding immersion in snow removal chemicals encountered on airport runways. The seals shall not deteriorate while exposed to the chemicals and the finish shall be resistant to corrosion.

3.2.5 Structural Integrity Requirements
The equipment is to withstand the mechanical stresses described below without damage or deterioration of performance.

3.2.5.1 Vibration
The light fixture shall be capable of withstanding vibrations in the frequency range of 10 to 2,000 Hz in the transverse, longitudinal, and vertical directions. See paragraph 4.5.10(b) for limits.

3.2.5.2 Static Load
When installed according to the manufacturer's recommendations, the light fixture shall withstand a static load (in lbs) of 500 times the top area of the light fixture (in in^2) distributed uniformly over the top surface of the light fixture.

3.2.5.3 Dynamic Load
The light fixture, shall withstand the impact and vibration loads imposed by service vehicles with and without snow chains (snow plows, snow blowers and wire brush sweeping equipment) and aircraft during their operational phases (taxiing, taking off, landing, stopping and turning on the light unit). The light fixture when equipped with a snowplow ring, shall withstand snowplow impacts without deterioration in materials or operational degradation.

3.2.5.4 Shear Load
The light fixture shall withstand shear loads imposed by aircraft during their operational phases (taxiing, taking off, landing, and stopping) applied to the top of the light fixture in any direction parallel to the mounting surface.

3.2.5.5 Torque Load
The light fixture shall withstand a torque load applied to the top surface of the light fixture in any direction parallel to the mounting surface. This requirement approximates the torque generated by an aircraft tire inflated to 250 psi being twisted around the center of the light fixture in a locked-wheel turn.

3.2.5.6 Hydraulic Load

The light fixture shall withstand momentary hydraulic pressure of 250 psi that may be created by aircraft tires moving at high speeds during operations in wet weather.

3.2.5.7 Mechanical Impact

The light fixture shall withstand the repeated impact of a steel ball with 30 lb/ft (40 J) of energy.

3.2.5.8 Light Window Load

The light window shall support a load of 500 psi over the area of the opening when applied directly to the light window surface.

3.2.6 Electrical Integrity Requirements

3.2.6.1 Conducted Emissions

Conducted interference levels on incoming AC power leads, control leads, and signals leads shall not exceed the limits for CE102 as defined in MIL-STD-461 using a frequency range of 10 KHz to 10 MHz.

3.2.6.2 Radiated Emissions

Radiated emission shall not exceed the limit for RE102 of MIL-STD-461 using a frequency range of 2 MHz to 10 GHz. Figure RE102-4 for ground applications is to be used for the RE102 limit. If the emission measurement is made at a distance other than 1m, as described in MIL-STD-461, the RE102 limit line of figure RE102-4 is to be adjusted over the frequency range measured for the distance at which the measurement is taken, not to exceed 6.1m (20 feet).

3.2.6.3 Conducted Susceptibility

Conducted Susceptibility of the system shall be in compliance with CS114 of MIL-STD-461. The frequency range is to be 10 kHz to 200 MHz, and Curve #2 of Figure CS114-1 of MIL-STD-461 shall be used for the limit in accordance with Table III for Navy ground equipment.

3.2.6.4 Radiated Susceptibility

Radiated Susceptibility of the system shall be in compliance with RS103 of MIL-STD-461. The frequency range is to be 2 MHz to 18 GHz. The electric field intensity is to be in accordance with the limits for Navy ground equipment to Table VII in MIL-STD-461, RS103 limits for Navy ground equipment.

3.2.6.5 Transient Suppression

Specific transient events applicable to the equipment interfaces are characterized in terms of (1) input power disturbances, and (2) lightning-induced surges on the incoming lines.

a. The input lines shall be protected to withstand superimposed 500 V peak pulse amplitude with duration of 50 ms.
b. The interfaces shall be protected to withstand 10,000-A current surges that conform to the 10 by 20 µs waveform described in IEEE C62.41.2. The rise time of the applied voltage associated with this transient event is to be 10,000 V per µs minimum.

3.2.6.6. Dielectric Strength

High voltage leads shall be capable of withstanding twice the normal voltage plus 1000 volts DC. Low voltage leads shall be capable of withstanding 500VRMS AC. See MIL-STD-202, Method 301 for reference.

Transient suppression devices and EMI filters are not required to survive this level and may be disconnected for test purposes.

3.2.6.7 Ground Bonding

Safety ground connections to equipment chassis shall have less than 1 milli-ohm of resistance.

3.3 Materials and Parts

Materials, components, processes, and finishes are to be as specified herein. Materials and components not specifically designated herein shall meet the requirements of FAA-G-2100, paragraph 3.3.1. All parts of the light fixture shall resist corrosion and oxidation when subjected to continuous operating temperatures in the confined atmosphere of the light base, and when exposed to chemicals typically present on the airfield, including but not limited to oil, gasoline, aircraft fuel, deicing and anti-icing fluids. Electrical components are to meet the requirements specified herein unless otherwise noted in other parts of this specification. All material used in the construction and assembly of components, including the insulation of wires that are to be located near or in the lamp chamber, shall be ozone resistant. All components shall be moisture and fungus resistant and suitable for the intended purpose. No components shall be operated beyond the limitations recommended by their manufacturer.

3.3.1 Current-Carrying Components

Current-carrying components shall be fabricated of non-corrosive, high-conductivity materials. All current-carrying components in the light fixture requiring insulation shall be insulated for at least 1.5 times the operation voltage of the flash tube and shall be designed for a current-carrying capacity of 1.5 times the maximum operating current. All interconnecting cables shall be rated for a minimum of 1.5 times the maximum expected voltages in the circuits.

3.3.2 Wire

Connecting wires shall be copper, and shall have the proper insulation rating and adequate AWG size for the application, as specified in National Electric Code Article 310. Unless otherwise specified, the wires and wiring shall conform to the National Electrical Code for panel-board wiring. Stranded wire shall be used for wires and cables which normally are flexed in use and servicing of the equipment such as at terminal block termination. In all other applications, either solid or stranded wire may be used, provided that stranded wire shall be used where so indicated by good engineering practice. Wire that interfaces with external signals shall be chosen to also meet the dielectric strength requirements of section 3.2.6.6. All wires used in making circuit connections shall have a cross-section area-to-current ratio of not less than 500 circular mils per ampere for wire sizes No. 22 American Wire Gauge and larger.

3.3.3 Reserved

3.3.4 Reserved

3.3.5 Reserved

3.3.6 Reserved

3.3.7 Reserved

3.3.8 Electrical Connectors

Electrical connectors shall be in accordance with FAA-G-2100, section 3.3.1.4.3 and AC150/5345-26C except where connectors with pressure screw wire terminations are used.

3.3.9 Printed Wiring Assemblies (PWA)

All PWAs used in the equipment shall be conformal coated and be clearly identified/marked to assure correct identification and orientation, in accordance with FAA-G-2100, Section 3.3.1.4.7. Connectors on PWAs shall be keyed to the connectors they are intended connection to; this will prevent mating incompatible connectors.

3.3.10 Terminal Blocks

Terminal blocks shall be the enclosed base type with pressure-type terminal connectors. All terminals shall meet the requirements of Specification FAA-G-2100. Lexan protective covers with meter access holes shall be mounted above the terminal blocks. Only one wire shall be attached to each terminal block.

3.3.11 Hardware

All bolts, studs, nuts, and other similar fasteners not subject to high stress requirements shall be fabricated from 18-8 stainless steel, passivated, and free from discoloration. Lock washers shall be made of 410 stainless steel, and shall be given a black oxide finish in accordance with MIL-DTL-13924D, Class 3. Fixture mounting lock-washers shall be two part locking washers; split type locking washers shall not be used. The two part lock-washers should always be replaced when the light fixture is removed from the light base.

3.3.12 Gaskets and O-Rings

Gaskets and O-Rings used at joints shall be capable of sustained operation at environmental conditions specified in 3.2.4, and shall withstand deterioration caused by deicing and anti-icing fluids as specified in 4.5.9. Gaskets and O-Rings shall be low compression set silicone rubber conforming to ZZ-R-765, Class IIB Grade 60, or better, or neoprene.

3.3.13 Metals

Metals shall withstand the mechanical stress involved and shall be inherently corrosion resistant or suitably protected to prevent corrosion or oxidation under the service conditions. The use of dissimilar metals in contact with one another shall be avoided wherever practicable; however, if their use cannot be avoided, they shall be in accordance with MIL-STD-889.

3.3.13.1 Ductile Iron

Heat-treated ductile iron, if used, shall have the proper tensile and yield strength to meet the requirements set forth herein. Particular attention shall be paid to the proper Brinell hardness and elongation of the material. Protected plating shall be used on all cast and machined ductile iron surfaces.

3.3.13.2 Stainless Steel

Stainless steel, if used, shall meet the requirements of ASTM A890/A890M.

3.3.13.3 Aluminum

Cast or forged aluminum may be used. Cast aluminum, if used, shall meet the requirements of SAE-AMS-A-21180, and shall be impregnated in accordance with MIL-STD-276 or anodized as described in 3.3.16.2. Where screws or bolts are used in tapped aluminum parts, inserts shall be installed.

3.3.14 Glass

Glass used as an optical or structural part shall meet all requirements of this specification, which includes the requirements of MIL-DTL-7989 for Class B glass. Class C glass may be used, if required, for impact strength. The light output window shall be of borosilicate glass having an

average Young's Modulus of 9.1 x 106 and a Poisson's Ratio of 0.2, or equivalent. The glass shall be tempered to withstand thermal shock (paragraph 3.2.4.2). Glass parts shall be supported in such a way that they will not be damaged by vibrations, shocks, or defection of any component part.

3.3.15 Nameplates

Nameplates conforming to FAA-E-2100 paragraph 3.3.3.1 shall be installed at a convenient location for the maintenance technician on the light fixture and ICC. Each nameplate shall be attached with four aluminum rivets or drive screws, using sealant to prevent leakage.

3.3.16 Protective Coatings

3.3.16.1 Conformal Coatings

Conformal coatings shall be limited to type AR, IPC-CC-830.

3.3.16.2 Anodizing

If required to pass any qualification test requirements, aluminum parts that would be exposed to continuous moisture, salt-laden atmosphere, or mechanical damage, shall be Teflon penetrated and hard coat anodized, meeting the requirements of MIL-A-8625, Type I or Type II, Class 1 or Class 2, as applicable.

3.3.16.3 Plating

All iron and steel parts shall be zinc or cadmium plated in accordance with QQ-Z-325 or QQ-P-4l6.

3.3.17 Sealing Compounds

Compounds used for sealing shall be run proof and shall not harden or crack. They shall remain mastic, and shall not lose water-sealing properties after exposure to the environmental conditions specified and shall withstand deterioration caused by deicing and anti-icing fluids. Sealing compounds shall be applied to all silicone gaskets or seals.

3.4 Processes

3.4.1 Assembly

Assembly of all units shall be in a permanent manner with the components accessible for servicing, replacement, or repairs. Bolts used in assembling units shall be equipped with captive nuts; bolt lengths shall be chosen so that at least three full threads will show over the nut after tightening. Lock washers of the internal tooth type shall be used on all bolts where good electrical continuity is required for grounding. The chassis shall not be used as a current-carrying part of the electrical circuitry.

3.4.2 Wiring

Wiring shall be in accordance with FAA-G-2100, and shall include provisions for strain relief. Insulated conductors may be closely grouped together, with the bundles secured by flame-retardant lacing or wiring clips and shall be properly trained and supported to avoid strain on the connections. Wire bends, with short radii shall be accomplished such a way as to avoid nicking or cutting the conductors.

3.4.3 Wire Terminations

Wires terminating at screw terminals shall have insulated crimp-on lugs with not more than one wire attached to each lug except for terminals having box-style contacts that completely enclose the wire. Short pieces of plastic insulating sleeves shall be forced over the wire insulation and lugs so as to reduce flexing of the wires at the lugs, or insulated lugs may be used where the lug

insulation grips the wire insulation. No more than two lugs shall be attached to each screw terminal except for terminals having box-style contacts. Non-soldered wrapped wire connections shall be prohibited. Soldering is permitted within components or assemblies. The equivalent wire gauge for all the wires shall not exceed the maximum wire gauge specified by the manufacturer for the terminal. Electrical contacts shall be made of coin silver material or equal material.

3.4.4 Marking

All equipment components shall be clearly identified by nameplates or bold permanent type stencils. Identification markings shall agree with designations on the wiring diagram and parts list. All control wires shall be provided with end identification in the form of a plastic band around the wire with identifying markings permanently stamped thereon, by markings permanently stamped into the wire itself, or other methods upon approval of the purchasing authority. All power conductors shall be similarly marked, except that a permanently stamped rigid laminate tag may be attached near the cable ends in lieu of the above. The terminating points for all wires and cables at terminal blocks, as well as the terminal blocks, shall be clearly identified. The identification shall correspond to the circuit and terminal designations as shown on the interconnection wiring diagram and on applicable diagrams contained in the Instruction Book.

3.4.5 Workmanship

Workmanship shall be in accordance with MIL-HDBK-454, Requirement 9, specifically:

a. Bearing Assemblies: Bearing assemblies should be free of rust, discoloration, and imperfections of ground, honed, or lapped surfaces. Contacting surfaces should be free of tool marks, gouge marks, nicks, or other surface-type defects. There should be no detrimental interference, binding, or galling
b. Wiring: Wires and cables should be positioned or protected to avoid contact with rough or irregular surfaces and sharp edges and to avoid damage to conductors or adjacent parts
c. Shielding: Shielding on wires and cables should be secured in a manner that will prevent it from contacting of shorting exposed current-carrying parts. The end of the shielding or braid should be secured to prevent fraying
d. Containment: The harness and cable form containment means should be neat in appearance, uniformly applied, and positioned to retain critical form factors and breakout locations. The containment means (lacing, ties, tie-down straps, etc.) should not cause the wire or cable insulation to deform so that performance characteristics are adversely affected

3.4.6 Brazing

Brazing shall be in accordance with MIL-HDBK-454, Requirement 59, except that electrical connections shall not be brazed. Paragraph 3.3 of Requirement 59 is not applicable.

3.4.7 Soldering

Soldering shall be in accordance with MIL-HDBK-454, Requirement 5.

3.4.8 Finishes

3.4.8.1 Surface Preparation

Surface preparation shall include masking, covering, or otherwise protecting surfaces not to be painted or primed. This includes interface contact surfaces requiring electrical continuity for grounding purposed.

3.4.8.2 Application

All primer and paint coats shall be applied in accordance with best commercial practices. The primer color shall be different from the intermediate coat to provide a color contrast between coats.

3.5 Parts Interchangeability

All parts furnished under a single procurement shall be manufactured to a tolerance that shall permit interchangeability of any part with a like part of any other unit. Identical components shall be identified with identical part numbers and unlike parts shall not have the same part number. This requirement does not prevent the readjustment or calibration of exchanged modules.

3.6 Maintainability

3.6.1 Maintainability Design Criteria

The following maintenance parameters must be met by the system:

a. Mean Time To Repair (MTTR) - The light fixture shall have a MTTR of not more than 30 minutes and 99 percent of all repair times shall be less than 2 hours. The contractor will demonstrate conformance of this requirement by performing maintainability analysis by using MIL-HDBK-472 as guidance
b. Mean Periodic Maintenance Time (MPMT) - The MPMT shall be not greater than 2 hours per 3 months, including routine inspection
c. Lamp Replacement - The design shall allow disassembling of the light fixture, removal and replacement of the lamp(s), without the use of power tools, and reassembling of the light fixture in not more than 12 minutes (including tightening to the manufacturer's recommended torques)

3.7 Reliability Design Criteria

3.7.1 System Reliability Definition

A system failure occurs when any component in the equipment prevents the system from meeting any requirement detailed in this specification.

3.7.2 System Reliability Parameters

Mean Time Between Failures (MTBF) of the equipment shall be not less than 7,000 hours, excluding the flashtube lamp. The flashtube lamp shall have a rated life of not less than 1,000 hours when operated within the light fixture at a maximum of 2,000 V, and at a flash rate of 2 times per second.

3.7.3 System Reliability Conformance

The contractor shall demonstrate conformance to this requirement by performing reliability analysis in accordance with MIL-HDBK-781, conducting demonstrations, and producing vendor parts data sheets in accordance with the contract.

3.8 Product Lifespan

The flasher unit shall be designed for an expected life-span of twenty (20) years minimum under the environmental conditions specified herein. This is to be interpreted to mean that the enclosures, mounting components, and major structural parts are to be designed to maintain the

aiming accuracies specified in section 3.2.2 for this period. Optical components are to be designed to maintain the light intensity required in section 3.2.2 by the use of periodic cleaning (no removal and reconditioning required).

4 Quality Assurance Provisions

4.1 Verification Requirements Traceability Matrix (VRTM)

Appendix B contains the VRTM for the flasher unit. Methods utilized to accomplish verification include:

a. Analysis - An element of verification that utilizes established technical or mathematical models or simulations, algorithms, charts, graphs, circuit diagrams, or other scientific principles and procedures to provide evidence that stated requirements were met
b. Demonstration - An element of verification that generally denotes the actual operation, adjustment, or re-configuration of items to provide evidence that the designed functions were accomplished under specific scenarios. The items may be instrumented and quantitative limits of performance monitored
c. Inspection - An element of verification consisting of investigation, without the use of special laboratory appliances or procedures, of items to determine conformance to those specified requirements that can be determined by such investigations. Inspection is generally nondestructive and typically includes the use of sight, hearing, smell, touch, and taste; simple physical manipulation; mechanical and electrical gauging and measurement; and other forms of investigation
d. Test - An element of verification that generally denotes the determination, by technical means, of the properties or elements of items, including functional operation, and involves the application of established scientific principles and procedures

4.2 First Article Units

First article units will be produced in the quantities required as defined in the Statement of Work (SOW) of the contract. The first phase of verification testing is Design Qualification Testing (DQT) to determine whether the design meets specified requirements. First article units will be used for performing the DQT of the product. If multiple first article units are required for initial DQT then all members of that group will be referred to herein as part of the first article. The units that are produced for field installation will be referred to here as “Production Units.”

4.3 Requirements Testing Discussion

The relationship amongst section 3 requirements, Tables III, IV, and V, and Appendix B, is as follows:

a. Section 3 of this specification lists the functional and performance requirements that the equipment must comply with
b. Table III (of Section 4.4) specifies the applicability of procedures defined in section 4.5 to the Design Qualification Test. Table IV (of Section 4.4) specifies the applicability of procedures defined in section 4.5 to the Production Acceptance Test for the production units. Table V (of section 4.4) specifies the applicability of the procedures defined in section 4.5 to the Type Test
c. The Verification Requirements Traceability Matrix (VRTM), in Appendix B, stipulates the method of verification (test, analysis, inspection, demonstration) for each “shall” require in section 3 of the specification and identifies which test or tests in section 4.5 verifies each section 3 requirement

4.4 Testing Methods

Testing of the equipment shall be performed as follows. It may be necessary to install the light fixture in an L-868 C light base during the conduct of the tests. Failure of the production model light fixture to pass the tests described in 4.4.1 shall be cause for rejection.

4.4.1 Design Qualification Test (DQT)

4.4.1.1 Precondition

The Visual Inspection (4.5.1) and Electrical Safety Tests (4.5.21) must be performed prior to any other DQT tests that require powering up the fixture.

4.4.1.2 Applicability

Any deformation, discoloration, deterioration, malfunction, or operation of the equipment outside of the prescribed conditions or limits of section 3 during or after the conduct of each test shall be cause for rejection.

4.4.1.3 Required Tests

The following tests shown in Table III, as defined in section 4.5 are required for Design Qualification Testing. In addition, the first article shall undergo tests described in 4.5.19 and 4.5.17 at the conclusion of each test for which it is indicated in Table IV.

TABLE III. Design Qualification Tests

"X"= Required, "-"= Not required

Test	Para. Reference	Light Fixture	ICC
Visual Inspection	4.5.1	X	X
Temperature	4.5.2	X	X
Thermal Shock	4.5.3	X	X
Altitude	4.5.4	X	X
Humidity	4.5.5	X	X
Sand and Dust	4.5.6	X	X
Rain	4.5.7	X	X
Fog	4.5.8	X	X
Immersion	4.5.9	X	-
Vibration	4.5.10	X	X
Static Load	4.5.11	X	-
Dynamic Load	4.5.12	X	-
Shear Load	4.5.13	X	-
Torque Load	4.5.14	X	-
Hydraulic Impact	4.5.15	X	-
Mechanical Impact	4.5.16	X	-
Light Window Load	4.5.17	X	-
Leakage Test	4.5.18	X	-
Electromagnetic Interference	4.5.19	X	X
Transient Suppression	4.5.20	X	X
Electrical Safety	4.5.21	X	X
Photometric, first article	4.5.22	X	X
Photometric, Production Unit	4.5.23	X	X
Accelerated Life	4.5.24	X	X
Two Hour Operational Test	4.5.25	X	X
Lamp Replacement Test	4.5.26	X	-
Reliability Demonstration	4.5.27	X	X

4.4.2 Production Acceptance Tests

4.4.2.1 Applicability

The Production Acceptance Test will be performed on all flasher units. First article units will be subjected to the production acceptance test prior to performing DQT. All production units shall pass the production acceptance test prior to delivery.

4.4.2.2 Required Tests

The following tests shown in Table IV, as defined in section 4.5, are required for all production units.

TABLE IV. Production Acceptance Tests

"X" = Required, "-" = Not required

Test	Para. Reference	Lamp Fixture	ICC
Visual Inspection	4.5.1	X	X
Electrical Safety	4.5.21	X	X
Leakage Test	4.5.18	X	-
Photometric, Production Unit	4.5.23	X	X
Two-hour Operational Test	4.5.25	X	X

4.4.3 Type Tests

4.4.3.1 Applicability

Tests shall be performed on regular production equipment or systems in accordance with the requirements in FAA-G-2100.

4.4.3.2 Required Tests

The following tests shown in Table V, as defined in section 4.5, are required for all Type Test Sample units.

TABLE V. Type Tests

"X" = Required, "-" = Not required

Test	Para. Reference	Lamp Fixture	ICC
Temperature	4.5.2	X	X
Humidity	4.5.5	X	X
Vibration	4.5.10	X	X

4.5 Test Procedures

The light fixture shall be tested in accordance with the tests specified herein and the failure criteria of MIL-STD-810 of paragraph 5.14. Failure of a component during test, that requires replacement to restore the unit to "as-built" condition, constitutes a failure.

4.5.1 Visual Inspection

The equipment shall be visually inspected for workmanship, fabrication, finishing, painting, and adequacy of selected parts.

4.5.2 Temperature Test

The high temperature test shall be in accordance with MIL-STD-810, Procedure II, Method 501.4, except that the temperature shall be +158°F (+70°C). The low temperature test shall be in accordance with MIL-STD-810, procedure II, Method 502.4, except that the temperature shall be -67°F (-55°C). Procedure II shall be performed for three cycles during the low temperature test. The altitude test may be combined with this test by operating the equipment at atmospheric pressures corresponding to -300 (-91.44 meters) and then again at 10,000 feet (3,048 meters) altitude at both the high and low temperatures.

During testing the light fixture shall be operated for a period of 24 hours. To simulate actual conditions, the light fixture shall be installed in a 15 inch FAA Type l-868 C light base, which is in turn, embedded in dry sand at least 6 inches on the sides and bottom. The test area shall be shielded from wind. Temperatures shall be measured as follows:

a. On the outside surface of the light fixture at point of maximum temperature. Temperature in excess of 167 º F(75º C) shall be cause for rejection
b. Air temperature inside light fixture. Temperature in excess of 320 º F (160º C) shall be cause for rejection
c. Flash lamp seal temperature in excess of 392 º F (200º C) shall be cause for rejection
d. Ambient temperature should be between 68 ºF and 86 ºF (20º and 30º C)

The light fixture shall be installed in pavement and operated at maximum intensity level for at least 4 hours in still air with an ambient temperature of at least 77°F (25°C). Temperature readings shall be taken to assure that the maximum surface temperature does not exceed 302°F (150°C). The light shall then be covered with the tire of an aircraft of at least 250 psi for a period of 10 minutes. A thermocouple shall be located between the hottest point of the light fixture and the tire to register the test temperature. Temperature readings shall then be taken to assure the maximum surface temperature does not exceed 320°F (160°C). The fixture shall be inspected for damage or leaks.

The ICC shall be installed in a temperature chamber and tested to the same temperatures and times as the light fixture.

4.5.3 Temperature Shock (Thermal Shock) Test

The light fixture shall be mounted on an L-868 C light base and subjected to a cycling test by operating the fixture at maximum intensity at room temperature (dry) for a period of not less than 4 hours. At the expiration of the "on" part of the cycle, the test unit shall be de-energized and immediately submerged under at least 1 foot of water. The temperature of the water before submersion shall be 41°F (5°C) or lower. The test unit shall remain under water for at least 4 hours. At the expiration of the "off" part of the cycle, the test unit shall be subjected to repetition of the above tests until a total of three "on-off" cycles have been completed. The test unit shall be immediately inspected at the completion of the third cycle. Evidence of glass breakage or lens damage, leakage of water into the unit, damage to any part of the unit, or equipment failure during the tests shall be cause for rejection.

4.5.4 Altitude Test

The altitude test shall be in accordance with MIL-STD-810, Procedure II, Method 500.4. The equipment shall be tested at atmospheric pressures corresponding to -300 feet (-91.44 meters) and 10,000 feet (3,048 meters) altitude, at both -67°F (-55°C) and +131°F (+55°C). This test may be combined with the temperature test of section 4.5.2 (see the description in that section).

The ICC shall be installed in a pressure chamber and tested to the same pressures and times as the light fixture. This test may also be combined with the temperature test of section 4.5.2 (see the description in that section).

4.5.5 Humidity Test

A humidity test shall be conducted in accordance with MIL-STD-810, Method 507.4, Procedure I, except that a total of three complete 24-hr cycles (72 h) shall be required (Table 507.2-I (cycle

5)). The maximum temperature shall be 131°F (+55°C) and the highest relative humidity shall be 95 percent instead of 75 percent.

4.5.6 Sand and Dust Test

A sand and dust test shall be conducted in accordance with MIL-STD-810, Method 510.4, Procedure I and Procedure II. The air velocities used in the sand and dust test shall be 5,700 ft/min and 1,750 ft/min, respectively. The test duration shall be 6 hours, and the equipment shall be rotated 120º twice during the conduct of the test. Deterioration of any part that prevents the light fixture from meeting all requirements shall be cause for rejection. This test is not required to be imposed on the light window/lens, and therefore appropriate masking may be applied to the window/lens surface during the test. A snow plow ring shall not be used as a shield. Deterioration of any part that prevents the ICC from meeting all requirements shall be cause for rejection.

4.5.7 Rain Test

A rain test shall be conducted. The rain test shall be in accordance with MIL-STD-810, Procedure I, Method 506.4. The wind velocity shall be 40 mph, and the rainfall rate shall be 4 in/hr. The light fixture temperature shall be at least 180°F (82°C) higher than the rain temperature at the beginning of each 30-min exposure period. The ICC temperature shall be stabilized for a period of not less than 4 hours.

4.5.8 Fog Tests

Fog tests shall be conducted as follows.

4.5.8.1 Salt Fog Test

A salt fog test shall be conducted for not less than 168 hours in accordance with MIL-STD-810, Method 509.4, Procedure I. The light fixture shall be exposed to salt spray for period of 72 hours, followed by a 48 hours drying period. At the conclusion of the test, salt buildup may be removed with tap water. Deterioration (rust, pitting, or corrosion, etc.) of any part that prevents the light fixture or ICC from meeting all requirements shall be cause for rejection. The salt spray is to have a concentration of 5 percent sodium chloride, by weight.

4.5.8.2 Potassium Fog Test

A potassium fog test shall be conducted in the same manner as the salt fog test described in the previous paragraph.

4.5.9 Immersion Test

The light fixture shall be completely immersed in deicing fluid at 194°F (90°C) temperature and a pressure of 250 psi for a period of 72 hours. The light fixture shall be operated for 2 hours at maximum intensity before the test and shall be operational at the maximum intensity during the test. After the immersion period, the light fixture shall be removed from the chemical bath and disassembled for inspection. There shall be no evidence of corrosion, electrical degradation, or leakage into the light fixture. The deicing fluid shall be of the potassium acetate type: Cyrotech E36 LRD (Liquid Runway Deicer), Safeway KA Runway Deicing Fluid, or equal. The concentration of the test fluid shall conform to the industry practice for application of deicing fluids and therefore, shall, be 50-percent potassium acetate and 50-percent water, by weight.

4.5.10 Vibration Test

A vibration test shall be conducted. The light fixtures complete with all parts and lamp(s), shall be installed on a light base and mounted securely on the test machine in a manner to simulate

installed conditions. The ICC shall be firmly bolted to a test fixture in a manner to simulate installed conditions. The ICC shall be vibrated along all three axis of the enclosure.

a. Vibration Planes – The light fixture shall be vibrated in three planes or directions as follows:
    (1) In a direction perpendicular to the test table (vertically)
    (2) In a direction parallel to the light beam axis (horizontally)
    (3) At right angles to the light beam axis (horizontally)
b. Frequencies – The test assembly shall be vibrated through a frequency range of 10 to 2,000 cycles per second, in each plane, until the accelerations shown in Table VI are reached. Duration of each sweep shall be 10 minutes. Electrical continuity through the lamp shall be continuously monitored under full load conditions. If the gas tube or lamp envelope in the light fixture fails at any point in the range of frequencies, the test shall be continued and completed on the unit alone. Then a new lamp shall be installed and the unit shall again be vibrated in three planed through the frequencies of 55 to 2,000 Hz as 3 gravities (G). Failure to meet these requirements shall be cause for rejection of the unit of the lamp mounting method or both.

TABLE VI. Vibration Test Data

Acceleration in G's	**Frequency (Hz)**
0.020 inch (.5mm) double amplitude (Peak to Peak displacement)	10-70
5	70-200
10	200-500
15	500-2,000

Following the vibration test, the equipment shall be thoroughly examined for mechanical failure of any component, loosening of any part, cracked or broken seals, continuity of electrical circuits, and possible damage to supports, etc.

4.5.11 Static Load Test

The static load shall be applied vertically in a manner to distribute the load uniformly over the light fixture spanning the light base. The load shall be applied upon the upper surface and within the inner edge of the light base flange. The load shall be applied to the surface of the light fixture through a rubber pad having a Shore A hardness of 55 to 70, of 1 in. thickness and 1 in less than the diameter of the unit. The load shall be applied uniformly over the rubber at a rate not greater than 10,000 lbs/min. The full load shall be applied for at least 1 minute. The full load shall be applied for 10 repetitions at the stated rate.

A Finite Element Method (FEM) stress analysis shall be prepared. Additionally, a stress strain curve shall be prepared and presented at the Critical Design Review (CDR) for the metal of which the load carrying parts of the light fixture are to be made. The maximum allowable stress at the elastic limit shall be identified, and one-half that maximum stresses shall be calculated and identified as the maximum allowable working stress. The light fixture shall be designed so that the stress analysis indicates that no element of the light fixture is stressed above the maximum allowable working stress when the unit is subjected to the full load.

4.5.12 Dynamic Load Test

A dynamic load test shall be conducted. The light fixture and a contractor-provided snowplow ring shall be mounted in a Contractor-provided light base installed in pavement. The snowplow ring shall resist snowplow blade damage to the top of the light fixture. The light fixture and snowplow ring shall be traversed at 35 mph, using an Oshkosh P Series or H Series plow vehicle, or equivalent, equipped with a Wausau BMP 2250 (HW) steel-edged blade, or equivalent, with its blade set to a clearance of not more than 0.25 of an inch above the pavement. The vehicle shall be equipped with snow chains. During this test, the blade shall pass over the light fixture five times, i.e., from 0^0 (towards center of light windows), 45^0, 90^0, 135^0, and 180^0. In three of these passes, the tires and snow chains shall also pass over the light fixture. There shall be no damage that would render the light fixture unfit for service.

4.5.13 Shear Load Test

The shear load test shall be conducted in a manner to distribute a load of 6,000 lbs uniformly over an area bounded horizontally by the diameter of the light fixture and vertically by the portion of the light fixture projecting above the top elevation of the light base flange. The load shall be applied for a total of 100 repetitions. The load shall be applied and relieved at a rate of 2,000 lbs/min, with the maximum load being held for 10 minutes for the first application and for 10 seconds for all succeeding applications.

4.5.14 Torque Load Test

The torque load test shall be conducted by application of a vertical load of 250 psi uniformly applied to the entire top of the optical assembly. The torque load shall be 8,000 ± 5 percent ft-lbs for light fixtures of nominal 12-in diameter and 17,000 ± 5 percent ft-lbs for light fixtures of nominal 15-in diameter. The torque shall be applied in the horizontal plane, i.e., the plane of the runway. The torque loading shall be applied for 100 repetitions at a loading and unloading rate of 2,000 ft-lbs/min with maximum load being held for 10 minutes for the first application and for 10 seconds for all succeeding applications. The vertical load shall be held at the specified value during torque loading and unloading. The loads shall be applied in a manner to distribute the loads uniformly over the light fixture. Torque shall then be applied until slippage occurs and the maximum value reached recorded. The light fixture shall then be inspected and any damages shall be cause for failure. In lieu of this test, a stress (finite element) analysis may be submitted to establish that the light fixture will survive the combined stress created by similar applied torque and dead load.

4.5.15 Hydraulic Load Test

The light fixture shall be submerged in water to a depth of approximately 0.50 in. The upper surfaces of the light fixture around the windows shall be encased in a leak-proof metal housing with a 1-.75–in diameter steel piston. The chamber shall be filled with water and purged of all air. A 5-lb steel ball shall be dropped 6 ft onto the piston. The light fixture must not have any

mechanical failure, optical damage, or water penetration into the optical cavity after this test has been repeated five times.

4.5.16 Mechanical Impact Test

The light fixture shall be mounted rigidly on either a 1 inch thick steel plate or a concrete base at least 4 inches thick. The dimensions of the steel or concrete base shall be at least 3x3 ft. The light fixture shall be operational at maximum input voltage for at least 2 hours prior to starting the test. With the lamp still operational at maximum input voltage, a case hardened steel ball weighing 5 lbs (2.28 kg) shall be dropped 10 times at various locations around the top of the light fixture from a height of 6 ft (152.4 cm) with a 5-min interval between each drop. The ball shall be steel and case hardened to Rockwell C50-C53. Upon conclusion, the light fixture shall be opened to determine if the light fixture has been damaged or any component displaced. Any evidence of damage, including lamp envelope and filament, shall be cause for rejection.

4.5.17 Light Window Load Test

The light output window shall be subjected to a uniformly distributed load of 500 psi over the area of the window opening. Either a static load or a hydrostatic pressure test may be used.

The static load, if used, shall be applied through a 1 inch thick rubber pad having a Shore A hardness of 55 to 65. The contour of the rubber block shall be similar to, but not larger than, the exposed window. The test load shall be applied to the rubber pad and window through a steel plate 1 inch thick with a shape similar to, but not larger than the rubber pad. The load shall be applied perpendicular to the exposed window face at a rate of 1,000 lbs/min and the total load maintained for not less than 2 minutes.

The hydrostatic pressure test, when used, shall require a compartment to enclose the window and a section of the top of the light. The compartment shall have sufficient height to contain any test fluid not less than one inch depth above any enclosed part of the fixture. The test pressure shall be applied at a rate not to exceed 200 lbs/min and the total pressure shall be maintained for not less than 2 minutes. The window shall not crack or be permanently displaced or damaged by the test.

4.5.18 Leakage Test

A leakage test shall be performed after the light fixture has successfully passed the load tests of paragraph 4.5.11 through 4.5.17 and shall also be performed on all production units. Prior to performing this test, the wire leads shall be subjected to a tension equal to the weight of the light fixture (44 lb maximum) for 5 min to test the integrity of the seal where the leads enter the light fixture. The light fixture shall then be submerged in water at least 3 in below the surface, subjected to an internal air pressure of 20 psi, and maintained for a period of 10 minutes. Any leakage shall be cause for rejection. Leakage tests on production units may use this method, a gas leak detector, or other approved method to ensure that the light fixture is watertight.

4.5.19 Electromagnetic Interference Test

A production model of the light fixture and ICC together shall be tested for conformance to the electromagnetic interference control requirements specified in 3.2.6. The electromagnetic interference measurement shall be in accordance with the following test methods of MIL-STD-461:

Conducted Emissions	CE102

Radiated Emissions	RE102
Conducted Susceptibility	CS114
Radiated Susceptibility	RS103

4.5.20 Transient Suppression Test

A surge generator shall be used to superimpose on power and control lines each of the applicable types of transients specified in 3.2.6.5 at least five times. Both the lines from the ICC to the MALSR or ALSF-2 controller and the lines from the ICC to the light fixture shall be tested. Transient surges shall be applied between each line and the case. The preset transient control levels shall be verified by open-circuit and short-circuit tests prior to applying each test surge to the unit. The time interval between successive superimposition of test surges shall be no more than 30 seconds.

4.5.21 Electrical Safety

4.5.21.1 Dielectric Test

A dielectric test shall be performed on the leads of the production models in accordance with MIL-STD-202. The test shall be performed using 60Hz ac voltage applied for 1 minute between insulated leads and the chassis in grounded water. The power and high voltage leads (more than 250V) shall be tested at twice the operating voltage + 1000VRMS, after which, control lines shall be connected and tested at 500VRMS. Transient suppression devices and EMI filters are not required to survive this level and may be disconnected for test purposes.

Power and high voltage lines	2X operating voltage + 1000V RMS
Control lines	0.5 kilovolt (kV) RMS

4.5.21.2 Ground Bonding Test

A ground bonding test shall be performed on the light fixture by passing a current of 25 Amps or more through the chassis to a wire connected to the safety ground terminal. The measured impedance shall be 1 milliohm or less. This test may be performed using a manual or automatic tester.

4.5.22 First Article Photometric Test

Photometric tests shall be conducted on the equipment, with the snow plow ring installed, to demonstrate compliance with the intensities and beam dimensions of paragraph 3.2.2. Photometric tests shall be conducted in accordance with FAA-E-ll00 (photometric test procedures for condenser discharge lights). Test results shall include a graph showing the effective candela curve for each intensity setting and oscilloscope photographs of the pulse shape and deviation. The photometric measurements shall be obtained using a flash duration described in paragraph 3.2.2 with cable lengths of 10-ft and 450-ft and measuring the photometric only at the center of the light beam. Photometric measurements shall be taken with at least five random production-run lamps. For the reduced intensities, verification of the center-of-beam intensity is sufficient.

If the light fixture is designed so that any portion of the exterior lens or prism is below pavement level, that portion shall be obscured by opaque tape, but no more than half the lens area shall be blocked. The resulting intensity distribution shall be no less than 50 percent of that required. The center of the light beam may be shifted ±0.5° vertically and ±1.0° horizontally to meet the photometric curve.

The light fixture shall be tested at 17 positions as follows:

a. On beam vertical axis at 2.0, 4.50, 7.0, 9.50, and 12.0 above grades
b. At +/- 7.50 horizontally from the beam vertical axis, at 2.0, 4.50, 7.0, 9.50, and 12.0 above grade
c. At +/- 15.0 horizontally from the beam vertical axis at 7.0 above grade

4.5.23 Production Unit Photometric Test

All production fixtures shall be tested to verify that the photometric output meets the requirements of 3.2.2. The method used shall be provided by the manufacturer and approved by the FAA.

4.5.24 Accelerated Life Test

4.5.24.1 Light Fixture including Flashtube

The light fixture shall be set in dry sand at a stabilized temperature of at least 131°F (+55°C), simulating its installation in pavement. The sand shall be at least 5 inches thick around the sides and bottom of the fixture. The sand shall fill any openings in the light fixture that would be below pavement level. The unit shall be operated for at least one-half the rated lamp life at maximum intensity. The flash rate shall be 120 +/- 2 per minute for all three intensities without 2 consecutive misfires. After this, all sand shall be removed and the photometric performance of the unit shall be measured. Intensities shall not be less than 80 percent of the intensities specified. After this test, the light fixture shall be taken apart and thoroughly examined. Any deforming, blistering, heat damage or corrosion shall be cause for rejection.

4.5.24.2 ICC

The ICC shall be placed in a chamber at a temperature of at least 131°F (+55°C). The flash rate shall be 120 +/- 2 per minute for all three intensities without 2 consecutive misfires. After this test, the ICC shall be taken apart and thoroughly examined. Any deforming, blistering, heat-damage, or corrosion shall be cause for rejection.

4.5.25 Two-Hour Operational Test

The equipment shall be tested for 2 continuous hours at an ambient temperature of +77° ±18°F (+25° ±10°C). The unit will be flashed twice per second during this time and monitored for misfires or extra flashes. Two misfires in a row constitute a failure.

4.5.26 Lamp Replacement Test

A light shall be mounted in an L-868 C light base that has been installed in a manner similar to an actual installation in an airport runway. Using the tools and processes described in the Contractor-provided Instruction Book, a Contractor-provided technician will remove the light fixture that is at ambient temperature, replace the lamp(s), and return the light fixture to service. The times to accomplish this task shall not exceed the times stated in paragraph 3.2.6.

4.5.27 Reliability Demonstration

The contractor shall conduct accelerated life testing of the light unit and the ICC to demonstrate that these subsystems designs and production units meet the contract requirements.

The Contractor shall develop an accelerated life testing model and plan in accordance with MIL-HDBK-388B Section 8 appropriate to the design requirements for electrical, thermal structural and functional performance specified in the contract and the Contractor's design. After approval

of the accelerated test model and plan the Contractor shall execute the test plan using the test procedures described in paragraph 4.5.24.

5 Preparation for Delivery

Packaging requirements will be as specified in the contract or order (see MIL-STD-961, section 5.10).

6 NOTES

6.1 General

The contents of this paragraph are only for the information of the CO and other Government personnel. They are not contract requirements, and are not binding on either the Government or the Contractor, and have no force or effect. Any reliance placed by the Contractor on the information is wholly at the Contractor's own risk.

6.2 Other Equipment to be furnished

a. Instruction Manual
b. Six Spare Bolts and Six Lock Washers per flasher
c. Anti-Seize Compound

All necessary bolts, O-rings, silicone grease, washers, and lock washers, as well as a quantity of anti-seize compound shall be provided with each light fixture. The anti-seize compound shall be Loctite Nickel Anti-Seize Lubricant 771, or equal (28 grams minimum).

6.3 Deliverable Items

The following items should be called out in the contract documents as deliverable items under this specification:

a. Semi flush flasher light units
b. Semi flush flasher light unit instruction book
c. Quality assurance test procedures
d. Technical description of commercially available parts

6.4 Scheduled Events

The following scheduled events should be included in the Contract:

a. Preliminary Design Review
b. Critical Design Review

6.5 Certification

Certification, if called for in the Contract, should be in accordance with AC 150/5345-53B, [Airport Lighting Equipment Certification].

6.6 Documentation to be Furnished

Any deliverable documentation should be described in the Contract Data Requirements List (CDRL) of the contract or other applicable requirements of the contract.

6.6.1 Certification Documents

Insert requirements in the contract line items that prior to testing the production model, certification should be furnished to the CO that the materials used in the light unit meet the requirements stated in paragraph 3.6 and subparagraphs.

6.6.2 Instruction Book

Insert requirement in CDRL and SOW for an instruction book to be provided with each light unit or other appropriate quantity in accordance with FAA-D-2494, Appendix I, and Commercial Instruction Books. A soft copy of the instruction book should be supplied in a format and media approved by the CO.

6.6.3 Technical Descriptions

Insert all requirements in the CDRL and SOW for descriptive drawings of commercial parts (lamps, fittings, lenses, filters, gaskets, O-rings, etc.) to be furnished to the Government in order to permit procurement from sources independent of the Contractor. Drawings and associated data should be supplied in a computer-aided drafting (CAD) language file format and media approved by the CO. The description required should contain all relevant technical details including, but not be limited to, electrical, mechanical, physical, photometric, and chromatic characteristics.

6.7 Test Performance

All tests described in Section 4 shall be performed at the Contractor's expense. The following tests may be performed at the contractor's facility or an independent testing laboratory: 4.5.1, 4.5.24, 4.5.25, 4.5.26, 4.5.27. The following tests shall be performed at an independent testing laboratory: 4.5.2, 4.5.3, 4.5.4, 4.5.5, 4.5.6, 4.5.7, 4.5.8, 4.5.9, 4.5.10, 4.5.11, 4.5.12, 4.5.13, 4.5.14, 4.5.15, 4.5.16, 4.5.17, 4.5.18, 4.5.19, 4.5.20, 4.5.21, 4.5.22, 4.5.23. All DQT tests must be witnessed by the Government’s Test Director or his representative.

APPENDIX A: List of Acronyms

ALSF-2	Intensity Approach Lighting System with Sequenced Flashing Lights
ALSF-2/SSALR	Dual Mode High Intensity Approach Lighting
ASTM	American Society for Testing and Materials
CAD	Computer-aided drafting
CDR	Critical Design Review
DQT	Design Qualification Test
IFB	Invitation For Bid
ICC	Individual Control Cabinet
MALSR	Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights
MPMT	Mean Periodic Maintenance Time
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
PWAs	Printed wiring assemblies
RFPs	Request For Proposals
SIR	Screening Information Request
SOW	Statement of Work
VRTM	Verification Requirements Traceability Matrix

APPENDIX B: Verification of Requirements Traceability Matrix (VRTM)

I= Inspection, D= Demonstration, A= Analysis, T= Test

#	SEC#	HEADING	DESCRIPTION	DQT	OT&E	SEC. IV	Type Test
1	3.1	Equipment to be furnished	Each flasher unit is to be designed in accordance with all specification requirements and shall include the items below: ICC Light Fixture L-823 Receptacle Plug Kits Snowplow Rings		I		
2	3.2.1	Functional Requirements	The flasher units specified herein shall be designed for use in airport runways as a unidirectional light.	I			
3			The light fixtures shall be designed for mounting in a Type L-868 C light base, C (15 inch) as described in FAA Advisory Circular 150/5345-42 [Specification for Airport Light Base, Transformer Housings, Junction Boxes, and Accessories].	I	D		
4			The light fixture shall be designed so that it can be mounted in a light base along with a snowplow ring or adapter ring to resist damage to the top of the light fixture caused by snowplow blades.	T	D	4.5.26	
5			The light fixture shall be designed and tested such that it does not negatively impact aircraft operations.		D		
6			The light fixture shall be controlled by the ICC.	I	D		
7			The light fixture shall consist of a top cover assembly, an optical assembly, and a bottom cover assembly.	I			
8			The ICC enclosure shall consist of a rain-tight enclosure.	T		4.5.7	
9			The ICC shall provide interfaces to the existing MALSR or ALSF-2 units.	I	D		
10			All parts shall be mounted in such a manner as to ensure the flasher unit will withstand shocks and vibrations caused by aircraft or service vehicle. Adjustment and repairs shall be accomplished with commercially available tools.				

11			Means shall be provided on the light fixture to permit its removal for maintenance purposes; by one maintenance technician working alone, e.g., pry bar slots, indentations, extraction devices, or other suitable provisions.				
12	3.2.2	Photometric Requirements	The flasher units shall be designed to operate at three intensities as identified in Table I.	T	D	4.5.22	
13			These intensities shall be controlled by the ICC according to control signals received from the MALSR or ALSF-2 controllers.	D	D	4.5.22	
14			The effective intensity after a minimum of 250 hours of continuous operation (approximately 1.8 million flashes) shall be at least 70 percent of the initial value.	T		4.5.24	
15			The flash rate shall be 120 +/- 2 per minute for all three intensities.	T		4.5.25	
16			Two or more consecutive lamp misfires shall not be allowed.	T	D	4.5.25	
17			The design of the units shall prohibit random flashing.	T	D	4.5.25	
18			The flasher units shall produce flashes only when commanded by the MALSR or ALSF-2 controller.	T	D	4.5.25	
19			The flash duration between the beginning and end of that part of the flash when the instantaneous intensity exceeds the effective intensity shall be in the range of 250 to 15,000 milliseconds.	T	T		
20			The minimum illumination value shall be required to enclose an area of at least 10° vertically by 30° horizontally as follows: Within 2° to 12° above horizontal and within 15° left to 15° right of the vertical centerline of the light fixture as shown in Figure 2.	T		4.5.22	
21			The intersection of the major and semi major axes of the ellipse shall be at 7°±½° above the horizontal.	T	T	4.5.22	
22			A downward shift shall be not greater than one-half degree.	T	T	4.5.22	
23			The light pattern shall not cut off abruptly at the outer edges of the specified light pattern, but shall decrease gradually in intensity beyond the specified areas.	T	T	4.5.22	
24			If the light fixture has a downward sloping light channel toward the light windows such that part of the window area could be obstructed by water,	T	T	4.5.22	

			the resulting light intensity with the obstructed portion of the windows blanked out shall be at least 50 percent of the minimum value specified.				
25	3.2.3.1.1	Light Fixture Dimensions	The light fixture shall be mounted on an L-868 C light base, using a snow plow ring or adapter ring, with six 0.375 inch high-strength stainless steel bolts, flat washers and lock washers, as specified in paragraph 3.3.11, using a silicone or neoprene O-ring, as specified in 3.3.12.	D	D		
26			The light fixture shall have a projection that extends at least .25 inch down through the top flange of the L-868 C light base.	I			
27			The diameter of this projection shall be 0.06 in +0.00/-0.01 inch less than the nominal diameter of the top flange cutout of the L-868 C light base.	I			
28			The light fixture shall be designed to mount on an L-868 C base, whose top surface is 0.375 inch below grade or may be designed to fit atop a base placed up to 1.25 inches below grade.	A			
29			Light fixture bolt hole configuration shall match the top flange of the light base.	I			
30			In addition, the axis between one pair of bolt holes on opposite sides of the light fixture shall be perpendicular to the direction of the runway centerline.	I			
31			The top outer edge of the light fixture shall be at pavement elevation from: +0 -0.625 to: +0 / -0.625 inch when installed in the light base.	I	D		
32			No part of the light fixture shall exceed 0.75 inch height above the pavement.	A	D		
33			All edges above the pavement shall be rounded to no less than 0.0625 inch radius.	I			
34	3.2.3.1.2	Configuration	The light fixture shall have 30 inch electrical conductors to connect the light fixture to the plug receptacle.	I	I		
35			The cables shall be clamped to the base of the light fixture to provide strain relief for cables.	I	I		
36			The light fixture shall operate when the physical separation, as determined by the length of the interconnecting cable(s) between the light fixture, and the ICC is up to 450 ft of cable distance.	T		4.5.22	
37			The light fixture shall have an internal interlock switch.	I			
38	3.2.3.2	Top Cover Assembly	The top cover assembly shall withstand pressure from tires, mechanical impact, thermal shock,	T		4.5.11 4.5.17	

			and vibration without damage or loss of the watertight seal.			4.5.18	
39			The top surface of the light fixture shall be stainless steel or anodized aluminum and shall be smooth and free of sharp projections, which could damage tires and engage with snowplow blades.	I			
40			Any O-ring grooves shall have a surface finish of 64 micro-inches RMS maximum as defined in ANSI B46.1.	I			
41			The surface on the light fixture that mates with the light base flange shall have a smooth finish to provide good load transfer and sealing.	I			
42			The seating surfaces of the mating parts shall be flat to insure seating without rocking before being secured.	D			
43			No part of the top surface that protrudes above finished grade, excluding recesses, light windows and light channels, shall have a slope greater than 16 degrees.	I			
44	3.2.3.3	Bottom Cover Assembly	The bottom cover shall be airtight and watertight.	T		4.5.18	
45			Seals used shall prevent breathing with internal pressure changes due to varying lamp heat.	A			
46			Pressure within the light fixture shall not exceed 20 psi under any operating condition.	A			
47			A fitting shall be supplied to allow pressurization of the sealed optical assembly.	I			
48			An external ground lug of an appropriate type, based on the manufacturer's design, shall be included as part of the light fixture's external bottom cover assembly and no holes in the bottom cover assembly will be used in conjunction with this ground lug.	I			
49			The external ground lug shall accommodate at least a 6 gage wire.				
50			The external ground lug shall be located so as to not interfere with light base insertion/extraction.	D			
51			A nameplate designed in accordance to FAA-G-2100H for outdoor use only shall be attached to the bottom cover directing the installer to:	I			
52	3.2.3.4	Optical Assembly	The optical assembly shall produce aviation white light output as required by section 3.2.2.	A			
53			The optical assembly shall contain the lamps, lamp holders, lamp retaining hardware, interior lens(es), and reflector(s).	I			

54			Reflectors shall be provided with a finish of high specular reflectivity and shall be protected from dirt, tarnishing, and corrosion.	I			
55			The design of the optical assembly shall be such that no adjustment of the optics will be required in the field.	D			
56			The optical assembly shall have one flash tube if that is the technology used.	I			
57			The light window of the light fixture shall have an internal flange that will prevent the lens from being pushed back into the interior of the light fixture.	I			
58			The clearances between the lens and the metal surfaces of the light shall prevent cracking of the lens when the light fixture is subjected to the conditions specified herein.	I			
59			The clearance shall be chosen such that the possibility is minimized for shards of the Teflon\rubber snowplow blade edges to penetrate the area between the lens and the adjacent metal surfaces and cause leakage.	I			
60			The optical components shall be keyed so that they may not be reassembled incorrectly.	D			
61			Every time the lamp is replaced it shall be accurately and firmly positioned at the proper focal point.	I			
62			Any interior lenses shall be positioned in a secure manner.	I			
63			When the light fixture has been reassembled after maintenance, all components shall be properly aligned.	I			
64			When the light fixture has been reassembled after maintenance, water resistance shall be restored, and the required photometric characteristics maintained.	I			
65	3.2.3.5.1	ICC Dimensions	The cabinet shall be of sufficient size to accommodate all necessary components and wiring.	I			
66			Unsoldering of wires, wire harnesses, parts or assemblies shall not be required in order to gain access to terminals, soldered connections, mounting screws and the like during routine servicing and maintenance.	D			
67			When it is necessary to displace a part in order to check or remove another part, the former part shall be wired and mounted so that it can be	I			

			moved without being disconnected and without causing circuit detuning or instability.				
68			Removal of the front panel or any sub-chassis for maintenance purposes shall be accomplished without unsoldering or soldering of connections.	I			
69			The equipment shall automatically return to normal operation when input power is restored after a power interruption.				
70			All test points and controls for adjustments shall be located to preclude accidental shock to personnel engaged in normal operating or maintenance activities.				
71			Maintainability requirements for the cabinet shall be in accordance with FAA-E-2100H, section 3.2.4, Maintainability.				
72			The ICC shall have a maximum weight of 50 lbs (22.72 kg).				
73	3.2.3.5.2	ICC Configuration	The individual control cabinet components shall be packaged in an outdoor, water proof, dust tight, non-ventilated enclosure as specified herein.	I			
74			The cabinet shall be constructed of anodized aluminum or stainless steel and shall not bend or distort under normal methods of shipping, handling, and installation.	A			
75			Cabinet installation provisions shall include two 2-inch (5.08 cm) threaded fittings on the bottom surface of the cabinet along with mounting lugs located on the rear surface of the cabinet.	I	I		
76			A third fitting shall be furnished on the bottom of the cabinet surface to accommodate a 0.75 inch (1.9cm) flexible conduit.	I	I		
77			Warning signs shall be installed inside and outside the cabinet to warn of the presence of high voltages.	I	I		
78			Maintenance light shall be provided for servicing the interior of the cabinet.	I	I		
79	3.2.3.5.3	Interfaces	The ICC shall meet the interface requirements of a MALSR or an ALSF-2 as contained in the references of Table II.	I	D		
80	3.2.3.6	Snow Plow Ring	The snow plow ring, if used, shall not interfere with installation of the light fixture in the light base or degrade the photometric performance of the light fixture below minimum requirements.	T	T	4.5.12	
81			The snow plow ring shall not block the light.	I	I		
82	3.2.4	Environmental	The equipment shall be designed for outdoor	I			

		Requirements	installation and operation.				
83			Procedures for environmental testing shall be in accordance with the applicable sections of Section 4, Verification	I			
84	3.2.4.1	Temperature	The equipment shall withstand ambient temperatures that range from -67°F (-55°C) to +158°F (+70°C).	T		4.5.2	T
85			Temperature inside and outside of the light fixture shall be held to the minimum by utilizing efficient heat dissipation techniques and materials with high coefficients of heat transfer.	I			
86			The maximum allowable external top surface temperature in still air shall be 302°F (150°C).	T		4.5.2	T
87			The maximum allowable external top surface temperature with a tire mounted on a heavy vehicle resting on the light fixture shall be 320°F (160°C).	T		4.5.2	T
88	3.2.4.2	Temperature Shock	The external surfaces (including lenses) shall withstand exposure to a sudden application of cold water at a temperature of +32°F to +41°F (0° to +5°C) when the flasher unit has reached a stable operating temperature.	T		4.5.3	
89	3.2.4.3	Altitude	The pressure altitude shall range from -300 feet (-91.44 meters) to 10,000 feet (3,048 meters).	T		4.5.4	
90	3.2.4.4	Humidity	The equipment shall withstand relative humidity up to 100 percent, including conditions where condensation takes place in the form of both water and frost.	T		4.5.5	T
91	3.2.4.5	Sand and Dust	The equipment shall tolerate windblown dust particles of 20±5µm mean diameter blowing at 1750 ft/min (8.9m/s) and sand particles of 150 to 850 µm blowing at 3540 ft/min (18 m/s).	T		4.5.6	
92	3.2.4.6	Rain	The equipment shall be capable of withstanding windblown rain at a rate of 6 in/hr (1.6 mm/min) at wind speeds of 40 mph (18 m/sec).	T		4.5.7	
93	3.2.4.7	Salt Fog	The equipment shall be capable of withstanding salt and potassium-laden atmospheres with relative humidity as stated in 4.5.8.1 and 4.5.8.2.	T		5.6.8	
94	3.2.4.8	Immersion	The light fixture shall be capable of withstanding immersion in snow removal chemicals encountered on airport runways.	T		4.5.9	
95			The seals shall not deteriorate while exposed to the chemicals.	T		4.5.8	
96			The finish shall be resistant to corrosion.	T		4.5.8	
97	3.2.5.1	Vibration	The light fixture shall be capable of withstanding vibrations in the frequency range of 10 to 2,000	T		4.5.10	T

			Hz in the transverse, longitudinal, and vertical directions.				
98	3.2.5.2	Static Load	When installed according to the manufacturer's recommendations, the light fixture shall withstand a static load (in lbs) of 500 times the top area of the light fixture (in in^2) distributed uniformly over the top surface of the light fixture.	T		4.5.11	
99	3.2.5.3	Dynamic Load Impact	The light fixture, shall withstand the impact and vibration loads imposed by service vehicles with and without snow chains (snow plows, snow blowers and wire brush sweeping equipment) and aircraft during their operational phases (taxiing, taking off, landing, stopping and turning on the light unit).	T		4.5.12	
100			The light fixture when equipped with a snowplow ring, shall withstand snowplow impacts without deterioration in materials or operational degradation.	T		4.5.12	
101	3.2.5.4	Shear Load	The light fixture shall withstand shear loads imposed by aircraft during their operational phases (taxiing, taking off, landing, and stopping) applied to the top of the light fixture in any direction parallel to the mounting surface.	T		4.5.13	
102	3.2.5.5	Torque Load	The light fixture shall withstand a torque load applied to the top surface of the light fixture in any direction parallel to the mounting surface.	T		4.5.14	
103	3.2.5.6	Hydraulic Impact	The light fixture shall withstand momentary hydraulic pressure of 250 psi that may be created by aircraft tires moving at high speeds during operations in wet weather.	T		4.5.15	
104	3.2.5.7	Mechanical Impact	The light fixture shall withstand the repeated impact of a steel ball with 30 lb/ft (40 J) of energy.	T		4.5.16	
105	3.2.5.8	Light Window Load	The light window shall support a load of 500 psi over the area of the opening when applied directly to the light window surface.	T		4.5.17	
106	3.2.6.1	Conducted Emissions	Conducted interference levels on incoming AC power leads, control leads, and signals leads shall not be greater than the limits for CE102 as defined in MIL-STD-461 using a frequency range of 10 KHz to 10 MHz.	T		4.5.19	
107	3.2.6.2	Radiated Emissions	Radiated emission shall be not greater than the limit for RE102 of MIL-STD-461 using a frequency range of 2 MHz to 10 GHz.	T		4.5.19	
108	3.2.6.3	Conducted Susceptibility	Conducted Susceptibility of the system shall be in compliance with CS114 of MIL-STD-461.	T		4.5.19	

109	3.2.6.4	Radiated Susceptibility	Radiated Susceptibility of the system shall be in compliance with RS103 of MIL-STD-461.	T		4.5.19	
110	3.2.6.5	Transient Supression	The input lines shall be protected to withstand superimposed 500 V peak pulse amplitude with duration of 50 ms.	T		4.5.20	
111			The interfaces shall be protected to withstand 10,000-A current surges that conform to the 10 by 20 µs waveform described in IEEE C62.41.2.	T		4.5.20	
112	3.2.6.6	Dielectric Strength	High voltage leads shall be capable of withstanding twice the normal voltage plus 1000 volts DC.	T		4.5.21.1	
113			Low voltage leads shall be capable of withstanding 500VRMS AC. See MIL-STD-202, Method 301 for reference.	T		4.5.21.1	
114	3.2.6.7	Ground Bonding	Safety ground connections to equipment chassis shall have less than 1 milli-ohm of resistance.	T		4.5.21.2	
115	3.3	Materials and Parts	Materials and components not specifically designated herein shall meet the requirements of FAA-G-2l00, 3.3.1.	I			
116			All parts of the light fixture shall resist corrosion and oxidation when subjected to continuous operating temperatures in the confined atmosphere of the light base, and when exposed to chemicals typically present on the airfield, including but not limited to oil, gasoline, aircraft fuel, deicing and anti-icing fluids.	T		4.5.8	
117			All material used in the construction and assembly of components, including the insulation of wires that are to be located near or in the lamp chamber, shall be ozone resistant.	I			
118			All components shall be moisture and fungus resistant and suitable for the intended purpose.	I			
119			No components shall be operated beyond the limitations recommended by their manufacturer.	A			
120	3.3.1	Current Carrying Components	Current-carrying components shall be fabricated of non-corrosive, high-conductivity materials.	I			
121			All current-carrying components in the light fixture requiring insulation shall be insulated for at least 1.5 times the operation voltage of the flash tube.	I			
122			All current-carrying components in the light fixture shall be designed for a current-carrying capacity of 1.5 times the maximum operating current	I			
123			All interconnecting cables shall be rated for a	I			

			minimum of 1.5 times the maximum expected voltages in the circuits.				
124	3.3.2	Wire	Connecting wires shall be copper.	I			
126			Connecting wires shall have the proper insulation rating and adequate AWG size for the application, as specified in National Electric Code Article 310.	I			
127			Unless otherwise specified, the wires and wiring shall conform to the National Electrical Code for panel-board wiring.	I			
128			Stranded wire shall be used for wires and cables which normally are flexed in use and servicing of the equipment such as at terminal block termination.	I			
129			Stranded wire shall be used where so indicated by good engineering practice	I			
130			Wire that interfaces with external signals shall be chosen to also meet the dielectric strength requirements of section 3.2.6.6. All wires used in making circuit connections shall have a cross-section area-to-current ratio of not less than 500 circular mils per ampere for wire sizes No. 22 American Wire Gauge and larger.	T		4.5.21.1	
131	3.3.8	Electrical Connectors	Electrical connectors shall be in accordance with FAA-G-2100, section 3.3.1.4.3 and AC150/5345-26C except where connectors with pressure screw wire terminations are used.	I			
132	3.3.9	Printed Wiring Assemblies	All PWAs used in the equipment shall be conformal coated and be clearly identified/marked to assure correct identification and orientation, in accordance with FAA-G-2100, section 3.3.1.4.7.	I			
133			Connectors on PWAs shall be keyed to the connectors they are intended connection to; this will prevent mating incompatible connectors.				
134	3.3.10	Terminal Blocks	Terminal blocks shall be the enclosed base type with pressure-type terminal connectors.	I			
135			All terminals shall meet the requirements of Specification FAA-G-2l00.	I			
136			Lexan protective covers with meter access holes shall be mounted above the terminal blocks.	I			
137			Only one wire shall be attached to each terminal block.	I			
138	3.3.11	Hardware	All bolts, studs, nuts, and other similar fasteners not subject to high stress requirements shall be fabricated from 18-8 stainless steel, passivated,	I			

			and free from discoloration.				
139			Lock washers shall be made of 410 stainless steel.	I			
140			Lock washers shall be given a black oxide finish in accordance with MIL-DTL-13924D, Class 3.	I			
141			Fixture mounting lock-washers shall be two part locking washers; split type locking washers shall not be used.	I			
142	3.3.12	Gaskets and O-rings	Gaskets and O-Rings used at joints shall be capable of sustained operation at environmental conditions specified in 3.2.4				
143			Gaskets and O-Rings used at joints shall withstand deterioration caused by deicing and anti-icing fluids as specified in 4.5.9.	A			
144			Gaskets and O-Rings shall be low compression set silicone rubber conforming to ZZ-R-765, Class IIB Grade 60, or better, or neoprene.				
145	3.3.13	Metals	Metals shall withstand the mechanical stress.	T		4.5.11 to 4.5.17	
146			Metals shall be inherently corrosion resistant or suitably protected to prevent corrosion or oxidation under the service conditions.	T		4.5.8	
147			The use of dissimilar metals in contact with one another shall be avoided wherever practicable.	A			
148			However, if their use cannot be avoided, they shall be in accordance with MIL-STD-889.	A			
149	3.3.13.1	Ductile Iron	Heat-treated ductile iron, if used, shall have the proper tensile and yield strength to meet the requirements set forth herein.	I			
150			Particular attention shall be paid to the proper Brinell hardness and elongation of the material.	I			
151			Protected plating shall be used on all cast and machined ductile iron surfaces.	I			
152	3.3.13.2	Stainless Steel	Stainless steel, if used, shall meet the requirements of ASTM A890/A890M.	I			
153	3.3.13.3	Aluminum	Cast aluminum, if used, shall meet the requirements of SAE-AMS-A-21180.	I			
154			Cast aluminum, if used, shall be impregnated in accordance with MIL-STD-276 or anodized as described in 3.7.15.2.	I			
155			Where screws or bolts are used in tapped aluminum parts, inserts shall be installed.	I			
156	3.3.14	Glass	Glass used as an optical or structural part shall meet all requirements of this specification, which	I			

			includes the requirements of MIL-DTL-7989 for Class B glass.				
157			The light output window shall be of borosilicate glass having an average Young's Modulus of 9.1 x 106 and a Poisson's Ratio of 0.2, or equivalent.	I			
158			The glass shall be tempered to withstand thermal shock (paragraph 3.2.4.2).	T		4.5.4	
159			Glass parts shall be supported in such a way that they will not be damaged by vibrations, shocks, or defection of any component part.	T		4.5.11 to 4.5.17	
160	3.3.15	Nameplates	Nameplates conforming to FAA-E-2100 paragraph 3.3.3.1 shall be installed at a convenient location on the light fixture and ICC.	I			
161			Each nameplate shall be attached with four aluminum rivets or drive screws, using sealant to prevent leakage.	I			
162	3.3.16.1	Conformal Coatings	Conformal coatings shall be limited to type AR, IPC-CC-830.	I			
163	3.3.16.2	Anodizing	If required to pass any qualification test requirements, aluminum parts that would be exposed to continuous moisture, salt-laden atmosphere, or mechanical damage, shall be Teflon penetrated and hard coat anodized, meeting the requirements of MIL-A-8625, Type I or Type II, Class 1 or Class 2, as applicable.				
164	3.3.16.3	Plating	All iron and steel parts shall be zinc or cadmium plated in accordance with QQ-Z-325 or QQ-P-4l6.	I			
165	3.3.17	Sealing Compounds	Compounds used for sealing shall be run proof.	I			
166			Compounds used for sealing shall not harden or crack.	I			
167			They shall remain mastic.	I			
168			They shall not lose water-sealing properties after exposure to the environmental conditions.	I			
169			They shall withstand deterioration caused by deicing and anti-icing fluids.	I			
170			Sealing compounds shall be applied to all silicone gaskets or seals.	I			
171	3.4.1	Assembly	Assembly of all units shall be in a permanent manner with the components accessible for servicing, replacement, or repairs.	I			
172			Bolts used in assembling units shall be equipped with captive nuts.	I			
173			Bolt lengths shall be chosen so that at least three full threads will show over the nut after	I			

			tightening.				
174			Lock washers of the internal tooth type shall be used on all bolts where good electrical continuity is required for grounding.	I			
175			The chassis shall not be used as a current-carrying part of the electrical circuitry.	A			
176	3.4.2	Wiring	Wiring shall be in accordance with FAA-G-2100, and shall include provisions for strain relief.	I			
177			Insulated conductors shall be properly trained and supported to avoid strain on the connections.	I			
178			Wire bends, with short radii, shall be accomplish in such a way as to avoid nicking or cutting the conductors.	I			
179	3.4.3	Wire Terminations	Wires terminating at screw terminals shall have insulated crimp-on lugs with not more than one wire attached to each lug except for terminals having box-style contacts that completely enclose the wire.	I			
180			Short pieces of plastic insulating sleeves shall be forced over the wire insulation and lugs so as to reduce flexing of the wires at the lugs, or insulated lugs may be used where the lug insulation grips the wire insulation.	I			
181			No more than two lugs shall be attached to each screw terminal except for terminals having box-style contacts.	I			
182			Non-soldered wrapped wire connections shall be prohibited.	I			
183			The equivalent wire gauge for all the wires shall not exceed the maximum wire gauge specified by the manufacturer for the terminal.	I			
184			Electrical contacts shall be made of coin silver material or equal material.	I			
185	3.4.4	Marking	All equipment components shall be clearly identified by nameplates or bold permanent type stencils.	I			
186			Identification markings shall agree with designations on the wiring diagram and parts list.	I			
187			All control wires shall be provided with end identification in the form of a plastic band around the wire with identifying markings permanently stamped thereon, by markings permanently stamped into the wire itself, or other methods upon approval of the purchasing authority.	I			
188			All power conductors shall be similarly marked, except that a permanently stamped rigid laminate	I			

			tag may be attached near the cable ends in lieu of the above.				
189			The terminating points for all wires and cables at terminal blocks, as well as the terminal blocks, shall be clearly identified.	I			
190			The identification shall correspond to the circuit and terminal designations as shown on the interconnection wiring diagram and on applicable diagrams contained in the Instruction Book.	I			
191	3.4.5	Workmanship	Workmanship shall be in accordance with MIL-HDBK-454, Requirement 9.	I			
192	3.4.6	Brazing	Brazing shall be in accordance with MIL-HDBK-454, Requirement 59.	I			
193			Electrical connections shall not be brazed.	I			
194	3.4.7	Soldering	Soldering shall be in accordance with MIL-HDBK-454, Requirement 5.	I			
195	3.4.8.1	Finishes: Surface Preparation	Surface preparation shall include masking, covering, or otherwise protecting surfaces not to be painted or primed.	I			
196	3.4.8.2	Finishes: Application	All primer and paint coats shall be applied in accordance with best commercial practices.	I			
197			The primer color shall be different from the intermediate coat to provide a color contrast between coats.	I			
198	3.5	Parts Interchangeability	All parts furnished under a single procurement shall be manufactured to a tolerance that shall permit interchangeability of any part with a like part of any other unit.	I			
199			Identical components shall be identified with identical part numbers.	I			
200			Unlike parts shall not have the same part number.	I			
201	3.6	Maintainability	The light fixture shall have a MTTR of not more than 30 minutes.	A			
202			99 percent of all repair times shall be less than 2 hours.	A			
203			The MPMT shall be not greater than 2 hours per 3 months, including routine inspection.	A			
204			The design shall allow disassembling of the light, removal and replacement of the lamp(s), without the use of power tools, and reassembling of the light fixture in not more than 12 minutes (including tightening to the manufacturer's recommended torques).	T		4.5.27	
205	3.7.2	System Reliability	Mean Time Between Failures (MTBF) of the equipment shall be not less than 7,000 hours,	A, T			

		Parameters	excluding the flash tube.				
206			The flashtube shall have a rated life of not less than 1,000 hours when operated within the light fixture at a maximum of 2,000 V, and at a flash rate of 2 times per second.	A, T			
207	3.7.3	System Reliability Conformance	The contractor shall demonstrate conformance to this requirement by performing reliability analysis in accordance with MIL-HDBK-781, conducting demonstrations, and producing vendor parts data sheets in accordance with the contract.	D			
208	3.8	Product Lifespan	The flasher unit shall be designed for an expected life-span of twenty (20) years minimum under the environmental conditions specified herein.	A			

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